DOCUMENT RESUME

ED 117 658 CS 002 371

AUTHOR Smith, Marshall S., Ed.
TITLE Conference on Studies in Reading. Summaries of Panel Reports, Panels 1 through 10 (Washington, D.C., August, 1974).
INSTITUTION National Inst. of Education (DHEW), Washington, D.C.
PUB DATE Jun 75
NOTE 143p.; For the individual panel reports see related documents ED 106 830-831, ED 108 175-176, ED 112 390-393, and CS 002 364

EDRS PRICE MF-$0.83 HC-$7.35 Plus Postage
DESCRIPTORS *Conference Reports; Language Usage; Models; Motivation; Reading Ability; *Reading Comprehension; Reading Development; *Reading Research; *Reading Skills; Research Needs; Research Problems; Semantics; Word Recognition
IDENTIFIERS *National Conference on Studies in Reading

ABSTRACT

These short summaries of the reports from the National Institute of Education's Conference on Studies in Reading are intended to reflect accurately the general areas of research recommended by each of the 10 panels taking part in the conference. Each panel focused on a particular problem in reading, identifying general approaches, suggesting programs of research, and--within these programs--generating specific research projects. Subjects of the panels are: semantics, concepts, and culture; the structure and use of language; attention and motivation; modeling the reading process; assessment of reading comprehension; applications of existing reading comprehension research; reading comprehension and the high school graduate; learning and motivation in early reading; reading strategies for different cultural and linguistic groups; and essential skills and skill hierarchies in reading instruction. Complete reports for each of the ten panels are available in separate documents. (JM)

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CONFERENCE ON STUDIES IN READING

"It was unlawful, as well as unsafe, to teach a slave to read.

'It will forever unfit him to be a slave. He will at once become unmanageable and of no value to his master.'

These words sank deep into my heart. From that moment, I understood the pathway from slavery to freedom. Though conscious of the difficulty of learning without a teacher, I set out with high hope and fixed purpose, at whatever cost of trouble, to learn how to read."

Frederick Douglass

NATIONAL INSTITUTE OF EDUCATION

Washington, D.C.
June, 1975

PANEL SUMMARIES

NIE CONFERENCE ON STUDIES IN READING

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PREFACE

The National Institute of Education (NIE) came into being during 1972. Its authorizing legislation requires the NIE to:

- Help solve or alleviate the problems of, and achieve the objectives of, American Education.
- Advance the practice of education as an art, science, and profession.
- Strengthen the scientific and technological foundations of education.
- Build an effective education research and development system.

In order to aid in meeting these general objectives, the National Council on Education Research (NIE's policymaking body) approved the creation of five priority programs in December, 1973. One of the priority programs was Essential Skills.* Its purpose was:

> To investigate through research and development, ways to aid all children to obtain skills essential for functioning adequately in school and society.

The initial focus of the Essential Skills Program was in the area of reading. Broad guidelines for an NIE effort in reading had been developed in a small conference held on Cape Cod during the late summer of 1973.** During 1974, the Essential Skills Program carried out an intensive effort designed to formulate more specific plans for funding research and development activities in reading. A variety of meetings was held with groups of teachers, school administrators, and scientists to designate directions for the program. The most ambitious of the meetings was held in Washington, D.C., in August, 1974, and directly involved over 175 individuals--50 as Conference participants and 125 as consultants to the Conference. This volume summarizes the reports of all of the 10 panels of the August Conference.

The impetus for the Conference stemmed from a number of concerns about the state of Federal funding of research and development in education. Four concerns stood out in particular for reading.

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*During the past few months, the Essential Skills Program has been renamed the Learning Division of the Basic Skills Group. Both the Basic Skills Group and the Learning Division continue to follow the guidelines set out by the National Council in December, 1973 (above).

**See Miller, George A. (ed.) Linguistic Communication: Perspective for Research, International Reading Association; Newark, Deleware, 1974, 45 pp.

1. Research in the field of reading was fragmented and noncumulative.

2. The Federal Government was not making constructive use of the state of knowledge in the field in their decisions to fund new research and development.

3. There was a lack of positive and firm coordination between the Federal Government and the professional research and practitioner organizations around the country.

4. A large number of scientists in a variety of disciplines carry out research with relevance to reading. We considered it important to attract these scientists to work in the applied areas of educational research.

The Conference itself was a step in meeting these concerns. During the past year, the NIE has been developing plans for funding research and development in reading for the next two years. Suggestions from the Conference have played an important role in this process. But planning is an ongoing process and we hope by publishing and widely disseminating the reports from the Conference to stimulate discussion of the reports, of research and development in the field of reading, and, indirectly, of the plans of the Institute.

To some extent the format for the Conference was influenced by three other similar efforts of the Federal Government. In the area of health research, the conferences leading to the National Cancer Plan and the National Heart and Lung Institute Plan served as partial models. Within NIE, the Teaching Division had held a major planning effort in the area of teaching research during the early summer of 1974. The intent in each of these efforts was to develop a coherent set of documents that would be responsive to the needs of the American public and to knowledge in the field.

We felt it necessary to structure the Conference in two important ways. First, after extensive consultation with scientists and practitioners in the field we arrived at the conclusion that major efforts in the past had often ignored or down-played the critical importance of the stage of reading called "reading comprehension." Although we realized the impossibility of actually separating out "reading comprehension" from the earlier stage of learning to read--which requires the learner to be able to translate written letters and words into speech--our advice suggested that the comprehension or "reading for meaning" stage required far more attention than it had received in the past. Consequently, seven of the ten panels focused on problems in this area. Second, to direct the focus of the panels to planning future research we requested the panelists to organize their ideas into general approaches within the problem area, within the approaches to suggest programs for research, and, finally, when possible to specify particular research or development projects.

The seven panels addressing problems in comprehension spanned a wide range of concerns. The first three panels focused on basic research issues. Their panel reports are titled: Semantics, Concepts, and Culture; The Structure and Use of Language; and Attention and Motivation. The fourth panel was asked to consider the problem of Modeling the Reading Process. The fifth panel directed its attention to the issue of measuring how well people read and its report is titled Assessment of Reading Comprehension. The sixth and seventh reports directed themselves respectively at the practical problems of the Application of Existing Reading Comprehension Research and Reading Comprehension and the High School Graduate. The final three panels directed their attention to three pressing concerns in early reading: Learning and Motivation in Early Reading; Reading Strategies for Different Cultural and Linguistic Groups; and Essential Skills and Skill Hierarchies in Reading.

Although the reports have undergone some revision and editing since the Conference, the major part of the work was done in concentrated sessions in the space of a few days. The resulting documents are not polished or exhaustive. They are meant to be working documents to stimulate debate, suggestions, and comments. Such comments or requests for other reports should be directed to:

Director, Learning Division
National Institute of Education
Washington, D.C. 20208

The work of organizing the Conference was carried out by members of the Essential Skills staff at the NIE--each of the panels had an NIE staff person as a permanent liaison. Special acknowledgments are due to Susan Duffy and Donald Fisher for their assistance in preparing the reports for publication and to Arthur Young & Company for coordination and arrangements before, during, and after the Conference. Finally, the work of NIE cannot proceed without the kind of skill, involvement, and hard work given by the panel chairpeople, panelists, and consultants for this Conference. The ideas and emphases in the reports are the products of their cumulative expertise.

Marshall S. Smith
Conference Chairperson

LIST OF PANEL REPORTS AND CHAIRPERSONS

Dr. Marshall S. Smith, Conference Chairperson

1. Semantics, Concepts, and Culture, Dr. George Miller, Rockefeller University
2. The Structure and Use of Language, Dr. Thomas Trabasso, Princeton University
3. Attention and Motivation, Dr. Sheldon White, Harvard University
4. Modeling the Reading Process, Dr. Richard Venezky, Wisconsin University
5. Assessment of Reading Comprehension, Dr. Ernst Rothkopf, Bell Laboratories
6. Application of Existing Reading Comprehension Research, Dr. Lauren Resnick, University of Pittsburgh
7. Reading Comprehension and the High School Graduate, Dr. Mina Shaugnessy, City University of New York
8. Learning and Motivation in Early Reading, Dr. Richard Hodges, University of Chicago
9. Reading Strategies for Different Cultural and Linguistic Groups, Dr. Manuel Ramirez, University of California, Santa Cruz
10. Essential Skills and Skill Hierarchies in Reading, Dr. Irene Athey, University of Rochester

REPORT SUMMARIES

NIE CONFERENCE ON STUDIES IN READING

Editors:

Susan Duffy
Donald Fisher
Marshall S. Smith

INTRODUCTION

This volume contains short summaries of the reports from the National Institute of Education Conference on Studies in Reading. The summaries are intended to accurately reflect the general areas of research recommended by each of the panels. Thus they provide an overview of the results of the conference. The complete reports for each of the 10 panels are available in separate documents. Readers interested in exploring specific areas in greater detail should write to the Learning Division of NIE for copies of the full panel reports which interest them.

Each panel focused on a particular problem area in reading. Within each problem area, panelists identified general approaches; within the approaches they suggested programs of research, and within these programs they generated specific research projects where possible. The summaries which follow present abridged versions of the panel's discussions of the general problem area and of each approach recommended. We took care to convey both the panels' conceptualization of their problem areas and their notions of what approaches would be useful in attacking these problems. We also included capsule summaries of the programs of research recommended within each approach in order to familiarize the reader with the kinds of research the panels felt were needed. At the beginning of each panel report is a list of all approaches and programs for easy reference. The first page of each panel summary lists the panelists for the panel.

The reader will find that the panels differed with respect to their objectives and recommendations in a number of ways. Perhaps the most salient among these dimensions are the scope of the investigations recommendations by particular panels, the panels' orientation to their problem areas, viz. basic or applied, and the level of detail of their recommended research--global vs. detailed.

For example, with respect to scope, a substantial number of panels adopted a scope which is sufficiently broad to include many of the issues involved in understanding the process of reading and its acquisition (viz. panels 1, 2, 4, 5, 6, and 10). In fact, the Panel 5 report provides a strategy which might be used to organize many of the research programs summarized in this volume. Other panels deliberately restricted the scope of their recommendations.

While the orientation of certain panels was clearly "basic" in the sense that they raised fundamental questions concerning the nature of the reading process, other "applied" panels recommended research of a basic character as a part of their programs.

Panels also differed substantially in the level of detail of their recommended programs. Since this is a summary volume, detailed projects are not described. The reader would have to examine the panel reports themselves in areas in which such detailed information is desired.

PANEL 1

SEMANTICS, CONCEPTS, AND CULTURE

APPROACH 1.1: WORD RECOGNITION SKILLS

- Program 1.1.1: Word Recognition as Information Processing
- Program 1.1.2: Vocabulary Growth, Semantic and Conceptual Development
- Program 1.1.3: Optimizing Vocabulary for Comprehension
- Program 1.1.4: Cultural Differences in Word Recognition

APPROACH 1.2: SENTENCE COMPREHENSION SKILLS

- Program 1.2.1: Models for Processing Syntactic and Semantic Structures of Sentences
- Program 1.2.2: Syntactic Development
- Program 1.2.3: Comprehension of Sentence Meaning
- Program 1.2.4: Cultural Differences in Sentence Comprehension

APPROACH 1.3: TEXT COMPREHENSION SKILLS

- Program 1.3.1: Process Models of Text Comprehension
- Program 1.3.2: Procedures for Facilitating Comprehension
- Program 1.3.3: Development of Text Comprehending Skills
- Program 1.3.4: Cultural Differences in Text Comprehension

PANEL 1

SEMANTICS, CONCEPTS, AND CULTURE

Problem Area Statement

The problem for Panel 1 was to determine the nature of the contribution of lexical, semantic, conceptual, and cultural factors to reading comprehension. Persons may fail to understand what they read for any of several reasons. We can attribute many reading problems in the early years of school to failure to learn how to decode printed language into spoken language. Although as children grow older and enter high school, most have learned to decode accurately, still a large number of reading failures persist. Many of the later failures result from students' failure to master skills involved in comprehending. We believe that even among readers who are proficient decoders there will be a sizable proportion of comprehension failures, and that even if we could teach decoding skills more effectively than at present, many children would still be functionally illiterate in high school.

The problem area of Panel 1 is limited, therefore, to a consideration of problems of comprehension that we cannot attribute to decoding difficulties, whether those difficulties arise from lack of practice or from functional disorders of other types.

Relevant Research

We assume that current attempts to teach comprehension skills have not been as successful as we hoped because they have not been based on a valid description of those skills. At the present time, however, an active surge of research and theory construction has begun in the fields of psychology and artificial intelligence that is directly concerned with the structure and processes of any system able to understand and produce language. The "state of the art" in these fields is developing rapidly. It stands at different stages for the different approaches we recommend below, and will be characterized where relevant in the context of each approach.

Division of the Research

The problem area has been divided into three approaches: word recognition skills; sentence comprehension skills; and text comprehension skills. This division corresponds to the size of the units with which the reader must deal. Comprehension involves different processes at each level, and we need different kinds of research at each level.

One should not interpret the division to mean that there are three different kinds of reading--reading words, reading sentences, and reading texts. For the skilled reader, these are merely three aspects of an organic whole. For the poor reader, however, they represent alternative sources of difficulty that are ordered in complexity. If word recognition is deficient, it will affect both sentence and text comprehension; if word recognition is proficient but the student has difficulty constructing an interpretation for sentences, text comprehension will be affected. If word recognition and sentence comprehension are both proficient, a student may still have difficulty in relating the sentences of a text or in distinguishing what is important from what is subordinate or supporting information. All three types of difficulty have been reported, but at the present time we are unable to say which source of difficulty is most common or which deserves more intensive investigation.

APPROACH 1.1

WORD RECOGNITION SKILLS

Approach Statement

Explore the extent to which reading comprehension depends on readers' knowledge and recognition of the words they are reading.

Problem Description

The ability to assign meaning to a word one sees must clearly be distinguished from the ability to pronounce it correctly. Correct pronunciation depends on what we will call "decoding skills;" word comprehension depends on what we will call "word recognition skills." Although there is obviously more involved in comprehending a word than "merely recognizing it," "word recognition" has some currency in the educational community. Thus we will use it instead of "word comprehension" even though we may be extending it beyond its usual interpretation.

Children first learn words by hearing them used; there is no reason to think this ability is lost when they encounter the printed word. If unfamiliar words are not too large a portion of the text, children can probably guess their meanings on the basis of what would be reasonable to say in the given context. If guessing leads to confusion, they can have recourse to a dictionary--although we know little about the best form of word-books for children's use. If they must use the dictionary too often, however, they will have difficulty in remembering the thread of the text.

Still, reading is one way people learn new words, and it would be interesting to know--and possibly important for the authors of beginning readers to know--what conditions lead to learning something new and what conditions lead to frustration. Moreover, inasmuch as we can expect children with different cultural backgrounds to have different vocabularies, it is difficult to see how any single text could optimize the familiar-unfamiliar word ratio for everyone.

It seems plausible that children who must divide their attention between searching for the meanings of unfamiliar words and attempting to understand the message the text is intended to communicate will

comprehend less of what they are reading, will have less attention free for dealing with the message, than the children who know all of the words. As far as we know, however, this plausible hypothesis has never been convincingly demonstrated by educational research. And the kinds of confusions that can result from lexical (word) incompetence have never been diagnosed and classified for the purpose of different educational treatments.

The problem is further complicated by the fact that "knowing" a word is a relative matter. A reader may know something about the word--its syntactic category, perhaps, and the general semantic domain to which it belongs--without really being master of its precise meaning. Most words have several shades of meanings; a reader may be familiar with some and not with others, perhaps not with the meaning that is appropriate to the text. It is not difficult to imagine confusion and misunderstanding resulting from the fact that the readers themselves may not be aware of not knowing the meaning that the author intended.

These remarks should illustrate that we need merely to scratch the surface to find questions of pedagogical importance that we are unable to answer. The basic difficulty is that we do not know how lexical competence contributes to reading comprehension. On the assumption that students will acquire reading skills more quickly if they understand the words they are reading, some researchers have made efforts to determine what words children know and what words they should know, and to prepare basal readers that rely on the former and introduce the latter. That is to say, textbook authors are trying to avoid lexical difficulties for beginning readers, but we know little about the consequences for the children's learning and motivation.

Relevant Research

The organization of lexical knowledge and the processes whereby people exploit this knowledge in understanding discourse are active areas of research. The theories underlying this research come from linguistic and logical theories of the lexical component of language, and from ethnological and psychological theories of meaning and memory. We need to generalize these theories in order to include the learning process, and to realize them in terms of information-processing systems whose components we can study experimentally and explore by computer simulation. The research we suggest is intended to do just this.

Division of the Approach

Several models for the memory structures and retrieval processes involved in word recognition have been proposed, many in the form of, or inspired by, computer simulations of text-processing systems. If we can extend these models and take them as descriptions of the skills

children are expected to acquire, students of language can employ them to investigate semantic development and the factors that facilitate or inhibit it. A characterization of word recognition skills should facilitate educational development of age-appropriate and culture-appropriate materials. These considerations lead to a division of this approach into four programs:

(1) The first program will formulate an information-processing model of reading comprehension that adequately accounts for word recognition. Two components are essential to such a model. It must have a memory in which is represented information about the meanings of words and their syntactic possibilities, and it must have a processor that retrieves information from lexical memory and organizes it into executable programs. The goal of the research suggested in the first program is to use text-processing systems as an environment in which to explore the component of the total system corresponding to word recognition, and to use it as a source of hypotheses about memory organization and retrieval in people learning to read.

(2) We need a comprehensive theory of vocabulary growth and semantic development in children. Partially, this theory will concern the lexicon itself: what words children know, how they organize these words, and how they retrieve words from memory. The theory must also include an account of the process by which a child represents a newly encountered word as a word and begins to assign it meaning. To do this, a child must map that word onto his conceptual structure. Research within the second program is designed to provide some of the information necessary to understand these processes.

(3) The third program seeks ways to manipulate the vocabulary of reading materials in such a way as to facilitate comprehension. While deeper theoretical and empirical understanding of the role of lexical information in language comprehension would be of great value to psychologists and linguists, the potential for important educational applications based on that understanding depends on how effective present techniques are for dealing with the problem. For the majority of children (middle class, Standard English Speaking), present techniques are probably not far from optimal. However, if failures of word recognition are an important source of comprehension difficulties in children from subcultural groups, knowing how to optimize the choice of words in beginning readers would make a proportionately important contribution to the education of these children.

(4) The fourth program is designed to investigate vocabulary differences associated with the various cultural subgroups in our society and to arrive at a basic understanding of how cultural

factors affect children's comprehension of Standard English and their subsequent achievement in school subjects. Although we can see many effects produced by cultural differences, we have only the thinnest support for our conjectures concerning how a child's culture influences his comprehension skills. It seems highly probable that a considerable portion of that influence shows up in the form of peculiarities in words and concepts that children acquire within their cultural subgroups.

APPROACH 1.2

SENTENCE COMPREHENSION SKILLS

Approach Statement

Explore the extent to which reading comprehension depends on readers' ability to use his/her knowledge of sentence structure to understand conceptual relationships expressed within sentences.

Problem Description

Simple clauses and sentences are the building blocks of discourse. Children who have difficulty with them will be unable to comprehend texts in which they occur. Although most children acquire the basic grammatical rules of their native language by the time they are 4 years old, there is reason to believe that children continue to learn more complex grammatical rules for many years. Thus, grammatical constructions that appear simple to adults may be difficult for children. If children must devote conscious attention to grammatical complexities, they will be diverted from the central task of comprehending the message. At the present time, however, only fragmentary information is available about constructions that are difficult for school children and that should be avoided in those textual materials not directly intended to teach such constructions.

Relevant Research

While recent advances in the linguistic theory of syntax have stimulated considerable interest in the process of sentence comprehension, research has concentrated on adults and preschool children. We need similar studies on children of elementary school age. The past decade's experience should make it possible to avoid some of the unfortunate mistakes for which earlier work has been criticized.

Under the influence of Chomsky's earliest work, researchers on sentence perception, sentence memory, and sentence comprehension assumed that there is a stage in the process of sentence understanding that corresponds to parsing the sentence according to Chomsky's theory of sentence structure. Thus, it was believed that once the phrase structure of a particular sentence was extracted, the next step in understanding was to infer its deep structure--the simple

sentences that it contained and their relationship to one another. Given the deep structure, the final step was to consult the lexicon for interpretations of the words contained in the deep structure and so to construct a semantic representation for the sentence.

Efforts to characterize the psychological processes of sentence comprehension in terms of such linguistic theories of sentence structure were unsuccessful. Fodor, Bever, and Garrett (1974) have reviewed this work and have concluded that the comprehension process cannot use grammatical information in the same form in which a grammar represents it. As an alternative, they propose various heuristic strategies that might be used to identify clause boundaries, to identify the major verb in a sentence, and so on. Fodor et al. still assume, however, that the result of these heuristic strategies is to compute the same underlying grammatical structure that a grammar would compute.

Alternative approaches to sentence structure, however, have emerged from work on sentence processing by computer. For example, grammatical structures might be regarded as abstractions from what is basically an attempt to assign a semantic reading to the sentence (Davies and Isard, 1972). The semantic reading or interpretation of the sentence depends on the context in which the sentence occurs: The state of the system receiving the sentence, the higher order goals the system is attempting to attain, the particular situation at the time the sentence is used. This incorporation of contextual relations of the sort that occur in discourse into linguistic theory may result in linguistic theories which more closely reflect the psychological complexities inherent in the processing of connected discourse.

Division of the Approach

Approach 2 is divided into four programs intended to parallel those of Approach 1:

(1) A model of exactly how meaning or semantic readings are abstracted from surface print or speech is the goal of the first program. Work in this area is progressing in three different directions: computer simulations, psycholinguistic models, and philosophical theories. Many philosophers and linguists believe that psychologists do not understand what a theory of meaning is; many psychologists believe that philosophers and linguists are analyzing their own linguistic fantasies. The controversy indicates the need for some clarification of the conceptual foundations of work on meaning and comprehension. The first proposal, therefore, is not a program of empirical research, but the creation of a mechanism whereby funds would be available to support collaboration among various parties. Only then would it make sense to develop research and simulation applications of linguistic and philosophical theories of meaning.

(2) We must extend work showing that syntactic development is not complete by age 4 to include school age children. The first goal of research within the second program would be a catalog of constructions difficult for elementary school children. The real goal, of course, would be a statement, in terms of psycholinguistic theory, of why some constructions are developmentally more complex than others. Thus, we must do more than merely catalog constructions that school-age children cannot understand. The psychological methods that provide evidence for models of online speech processing in adults must be adapted for children. We must try to simulate processing at different ages.

(3) The third program will explore the extent to which we can manipulate ease of acquisition of meaning from sentences. The proposed program grew out of a view of sentence comprehension as problem solving. We can regard a sentence as a symbolic device which readers can use to acquire concepts that may be new. The words in a sentence represent some fairly general concepts that readers already know; the syntactic structure of the sentence specifies the order and manner in which they must combine these known concepts; and the result of these combining processes is some new concept. Thus the questions to be addressed within this program include: What is the nature of these combining processes? How can we adjust sentence structure and the instruction of students to influence the ease and accuracy with which they can employ these processes in reading comprehension?

(4) The fourth program suggests research bearing on claims that grammatical differences handicap poor children in understanding sentences in school. It is necessary to determine the extent of dialect divergence in the syntactic properties of sentences that speakers of nonstandard dialects of English use. Furthermore, it is important to gain some understanding of the relative frequency of different syntactic constructions within particular dialects.

APPROACH 1.3

TEXT COMPREHENSION SKILLS

Approach Statement

Identify those skills that are important for text comprehension as distinguished from word or sentence comprehension and determine how these skills can be taught.

Problem Description

A consideration of the skills needed for understanding words and sentences does not exhaust the list of skills needed for comprehension. In order to comprehend a text longer than one sentence, children must employ numerous additional skills to help construct a representation of the meaning underlying a set of connected sentences.

Although the process of text comprehension has not yet been described, a number of skills seem likely to be involved. Readers must be able to judge which elements of the text are most relevant to the "main idea." As they construct their own representation of the meaning of a text, readers must usually apply information they already know but which is not explicitly presented in the text. To understand a story about a vicious dog, it is essential to know that dogs bite and that they are more than a centimeter high, even if the story itself does not mention these facts. Similarly, readers are often required to make inferences not explicitly contained in the text. For example, if the text presents the information that a man was in a boat and the boat was being swept toward the rocks along the shore, then the reader should infer that the man was also being swept toward the rocks.

There is evidence that comprehension may be aided if a reader takes an active attitude toward the text. In some cases, readers elaborate on the information in the text by adding details of appearance, spatial and temporal settings, etc. in order to understand exactly what the writer intended. In other cases, such as arithmetic word problems, the reader may strip his representation of meaning to its bare essentials.

This discussion is by no means meant to be an exhaustive list of those special skills required for text comprehension. It should indicate, however, the variety of skills necessary to understand even the most simple of children's stories. Even if children are able to recognize most words and to understand most sentences out of context, they may still have problems understanding texts if they lack any one of the skills discussed above.

Relevant Research

Work on text comprehension is not yet far advanced. There are major gaps in our understanding of the anatomy of the text comprehension process and in our knowledge of the skills that make comprehension possible. A full discussion of most of the issues involved is to be found in the report of Panel 2.

In modeling the comprehension process itself, Panel 1 emphasized computer simulation studies. Computers seem most appropriate for modeling complex processes such as text comprehension. Work has proceeded on question-answering systems and natural language understanding systems for a number of years now, having met with considerable success. With this work as background together with several new developments in discourse comprehending systems, it seems likely that models of text comprehension can be developed rapidly.

Division of the Approach

The division into programs parallels the division of Approaches 1.1 and 1.2:

(1) The first program will attempt to develop process models of text comprehension. It will emphasize computer simulation studies which can be closely checked against observations of human performance. Artificial intelligence studies, while potentially of great value, seem less likely than simulation studies to generate ideas useful in practical reading contexts. Similarly, mathematical models or other less formal models seem less appropriate than simulation models for handling such complex processes as text comprehension.

(2) The aim of the second program is to develop procedures for facilitating the comprehension of text. While there is relatively little work in this area, and though what does exist is scattered, the practical importance of advances in this area is great. The research will focus on the importance of such factors as the reader's questioning skills, ability to make relevance judgments, knowledge base, and elaboration skills.

(3) Study of the development of text comprehending skills, as recommended in the third program, is important both for clarification of theoretical issues and for practical application. Developmental observations should help in understanding how the integrated package

of skills underlying adult competence in text comprehension is put together over time and hence should provide insights into its functioning. Such observations should also be directly applicable in the classroom to help define teaching goals and to determine performance expectations. If children at a given developmental stage cannot make relevance judgments, for example, then it is unreasonable to expect them to outline paragraphs well or to write sensible book reports.

(4) Research suggested by the fourth program is extremely important, for the percentage of children failing to attain adult literacy is especially great among some cultural subpopulations. Various lines of cross-cultural research are converging on the idea that cultural differences in cognitive tasks are attributable to factors that call particular operations into play and regulate their role in the performance of a task. It is important therefore to study not only cultural differences in the acquisition of cognitive skills, but also cultural differences in the way those skills are employed in particular situations.

PANEL 2

THE STRUCTURE AND USE OF LANGUAGE

APPROACH 2.1: STRUCTURAL ANALYSIS OF TEXT

- Program 2.1.1: Computer Models of Text Structure
- Program 2.1.2: Development of Text Grammars
- Program 2.1.3: Comparative Analysis of Texts

APPROACH 2.2: MEASUREMENT OF THE KNOWLEDGE ACQUIRED WHEN WE UNDERSTAND TEXT

- Program 2.2.1: Semantic Analysis of Knowledge "Recalled" from Text
- Program 2.2.2: Development of Chronometric Models that Test the Meaning Representation Derived from Text
- Program 2.2.3: Application of Explicit Models of Text Structure to Development of Tests of Comprehension
- Program 2.2.4: Individual Differences in Knowledge Structure Acquired from Text
- Program 2.2.5: Developmental Changes in Memory Structure
- Program 2.2.6: Oral Comprehension and Reading Comprehension

APPROACH 2.3: EFFECTS OF TEXT STRUCTURE ON DISCOURSE PROCESSING

- Program 2.3.1: Effects of Semantic Structure on Semantic Information Acquired from Text

APPROACH 2.4: KNOWLEDGE GROWTH AND USE

- Program 2.4.1: Comparison of Language Comprehension in Formal (Abstract) Situations to Contextually Rich Ones
- Program 2.4.2: Analyses of the Processes Involved in Decontextualizing Linguistic Knowledge
- Program 2.4.3: Finding Techniques for Understanding Understanding

APPROACH 2.5: BILINGUALISM

Program 2.5.1: Linguistic Description of Bilingual Populations
Program 2.5.2: Linguistic Transference
Program 2.5.3: Bicognitive Structures
Program 2.5.4: Cultural Variables

APPROACH 2.6: MODELS OF THE PROCESS OF EXTRACTING MEANING FROM DISCOURSE

Program 2.6.1: Models of Language Understanding
Program 2.6.2: Computer Models of Language Acquisition

PANEL 2

THE STRUCTURE AND USE OF LANGUAGE

Problem Area Statement

Most of what individuals are asked to read and understand goes beyond the single sentence. Comprehension tests typically ask for information that readers can supply only by analyzing several, perhaps distant, sentences. This panel's primary concern is with problems readers encounter in processing connected discourse, more simply called text.

It is commonly accepted that comprehension of text presents a problem for thousands, even millions of children and adults. The Armed Services are presently funding large research efforts aimed at redesigning training and on-the-job manuals in order to facilitate comprehension. Clear, readable prose is of interest to private industry as well.

In short, the problem is one with which many people are concerned. Unfortunately, very little is understood about the psychological mechanisms which account for or explain the text processing skills we know competent readers have. Thus, much of what we suggest in terms of research has a basic rather than applied character.

This panel will focus on the organizational properties of what writers and readers know; on the organizational properties of the message; on the means or processes by which writers create the message; on the processes by which readers comprehend the meaning of the message; on the structural properties of what information readers derive from the message and store in memory; and on the context in which the message occurs, including its social function or physical referents.

Though much of what we recommend has a basic research orientation, it is a clear first step in the direction of solutions to practical educational problems. The recommended research may identify procedures we can use to generate coherent texts that are readily understood, which communicate information accurately and efficiently. Once we know the developmental order in which students understand various constructions, the research could lead to a technology for writing children's readers that meet criteria of readability, interest, and appropriateness to age and experience. If we come to understand the details of the processes by which students understand printed material, we can locate problems in comprehension and design training procedures

to build in skills that lead to more efficient processing. Finally, once we understand how cultural experiences aid or hinder communication, we may find methods to create a shared knowledge base or transfer of language skills from one social situation to another.

Relevant Research

While the research recommended is admittedly ambitious, it is realizable. Through the recent efforts of linguists, philosophers, sociolinguists, logicians, computer scientists, and psychologists, a body of knowledge, skills, and methods has arisen which can shed light on these problems. The interdisciplinary character of the research attests to the complexity of the problem, as well as to the current interest in generating new knowledge and understanding among a variety of people of different backgrounds. This panel hopes to take advantage of this ferment of activity.

Division of the Research

The first three approaches recommend research on the structure of a text itself, on the structure of the information readers derive from the text, and on the effect of text structure on this derivation. Because structural characteristics are of interest, we recommend research on connected discourse involving more than single sentences. The fourth approach suggests that the context of a linguistic message and of linguistic knowledge become a focus of study. We recognize that language comprehension is highly dependent on context and recommend support of research which takes this into account in a systematic, process-oriented way. The fifth approach focuses research on bilingual students. We believe that the study of persons who must, of necessity, learn two languages is valuable for basic research and for social reasons. Finally, because highly organized and complex sequences of processes are involved in the generation and decoding of messages, the sixth approach recommends the exploration of these complex processes through methods adequate to handle such complexity, e.g., computer simulations.

APPROACH 2.1

STRUCTURAL ANALYSIS OF TEXT

Approach Statement

Explore and extend linguistic, psychological, and computational approaches to discourse (text) analysis and production.

Problem Description

Many lines of research depend on developing a method for analyzing and representing the underlying structure of text. Real problems individuals encounter in text processing cannot be properly investigated without a systematic representation of the information contained in the text itself. Without an analysis of the underlying structure of text (or the stated and unstated relationships which characterize it), it is difficult to engage in systematic comparisons of the information acquired through the comprehension process with the information actually contained in the text. Without the ability to perform these comparisons, designing clear, readable texts and constructing valid comprehension tests remains more of an art than the science it could become.

The problem of representing the underlying structure of a text is more problematic than it may seem at first thought. We can easily show by example that the information in a text goes beyond what is explicitly presented. Consider these sentences, similar to those one might find in elementary readers: "Mr. Munchkin was a fireman. Firemen must often risk their lives." The fact that Mr. Munchkin must often risk his life is not explicitly stated here. Yet clearly this relationship is part of what is implicitly contained in the text. An adequate representation of underlying text structure will make clear both the implicit and the explicit information as well as their interrelationships. Even more challenging might be the requirement that such a representation indicate the writer's intentions and assumptions.

Relevant Research

Until relatively recently, linguists influenced by Chomsky have tended to restrict their attention to the sentence as the largest unit of analysis. They have emphasized syntax at the expense of

meaning or semantics in representing sentence structure. Criticisms of these two aspects of Chomsky's theory, the emphasis on syntax and the adoption of the sentence as the unit of analysis, have motivated much recent work in linguistics and have led to a new emphasis on semantics and on discourse as the unit of analysis.

This approach also reflects the field's growing concern with context in connected discourse. Many researchers have critized focusing on the sentence as the primary unit of analysis and defining the grammaticality of a sentence without reference to the context in which the sentence occurs. They argue that speakers regularly produce sentences reflecting the context of the previous sentences produced. Any linguistic theory which ignores context in the production of individual sentences will be an inadequate model of a speaker's competence. In light of these considerations we have taken the text as the unit of analysis. This approach proposes the development of a text grammar. Such a grammar would not only be capable of generating individual sentences within a discourse, but would also be able to generate these sentences relative to the context of previous discourse.

In developing such a grammar we give attention to (a) the conceptual context of an utterance, i.e., the presuppositions (beliefs or intentions) held by the speaker at the time of an utterance; (b) the extralinguistic context, i.e., the time, place, and location of speakers and the identity of the speaker and hearer, and (c) the linguistic context, the context given by the previous discourse within which a sentence is embedded.

Division of the Approach

Research under this approach is divided into three programs:

(1) It seems possible to use existing linguistic knowledge and work in computational linguistics to write computer programs capable of generating and analyzing a restricted class of texts. There are two ways of implementing such a model. One is to write a program that will generate a text given an explicit set of rules and a propositional base. The second is to create a program which can analyze a text and derive its underlying structure. This latter method should deal with the problems of ambiguity and reference in the text.

(2) Linguists have only recently begun focusing on the text as the unit of grammatical analysis. This program will continue basic research in this area. It will attempt to identify grammatical rules which apply at the discourse level. Such research will include work on presuppositions, pragmatics, extralinguistic factors, and contextual effects exerted on a sentence by sentences preceding it.

(3) As we develop procedures for the structural analysis of texts, we can apply these procedures in comparing different texts. The ability to compare texts systematically will be useful for a

number of reasons. In current research on comprehension of connected discourse, it is difficult to generalize among studies because different texts are used. The problem of text similarity also has important applications in the design of texts used in instruction, especially when it is desirable to maximize the transfer of semantic information acquired from one text to that acquired from the next text in the sequence.

APPROACH 2.2

MEASUREMENT OF KNOWLEDGE ACQUIRED IN UNDERSTANDING TEXT

Approach Statement

Develop procedures using an analysis of the text structure as a basis for measuring the semantic and structural information listeners or readers acquire when they understand text. Using these procedures, determine what the relationship is between the semantic information contained in a text and the semantic information subjects acquire when they listen to or read the text.

Problem Description

When we say that readers have comprehended a text, we do not mean that they have in their memory an exact, word for word, copy of the text itself. In comprehending a text, readers transform the specific words and sentences into their own meaningful representation. For example, sentence boundaries are lost as readers construct propositions in memory. The two sentences, "The house stood on the hill. It was a large house with seven gables." might be transformed into a representation of "the large seven-gabled house on the hill." Similarly, readers will make inferences not explicitly expressed in the sentence.

The fundamental question of this approach is just what semantic or logical information listeners or readers acquire when they listen to or read textual materials. If one had available a detailed model of the semantic content of a text, and if one had available a detailed representation of the knowledge a subject had acquired from a text, then one could examine the relationship between the two structures. There is reason to believe that information in subjects' knowledge structures is of two sorts: information which reproduces the content that was read or heard, and derived information, which does not reproduce that which was explicit, but which relates to the content. Two questions in trying to characterize the comprehension process are: (a) What information and how much information presented in text do people incorporate into their memory structures? and (b) What sorts of derived information do they acquire? The answers to these questions should add much to our characterization of the mental operations involved in comprehension. Thus, by comparing a model of a person's

knowledge structure (inferred from one of the assessment procedures to be developed) to a model of a text, we should be able to reconstruct the processing operations people apply to an input text to generate the semantic information contained in their knowledge structure.

This approach is strongly related to the assessment issues discussed in Panel 5. Its results may make a valuable contribution to the methodology for constructing comprehension tests. The valid techniques for comparing the structure of a text and the structure of the reader's knowledge derived from the text and for characterizing the reader's mental operations, developed under this approach, should be modifiable for use in comprehension tests. Such tests will have the advantage of being of diagnostic value as well as permitting global comparisons to test norms. In addition, comprehension tests so constructed ought to have greater construct validity, where the idea of "construct validity" will have been precisely defined in terms of a model.

Relevant Research

There appears to be a consensus among a number of linguists, computer scientists, and psychologists that texts are derived from semantic networks or sets of interrelated propositions. Several detailed models of text structure are sufficiently well developed to be used as a basis for assessing semantic information acquired from text. Investigators have already developed necessary procedures for coding reproduced semantic information in recall of discourse, and progress in this area should be rapid. The most serious problems appear to be in analyzing the information in subjects' protocols which does not reproduce text content.

Division of the Approach

There are six programs in this approach:

(1-3) The first three programs under this approach focus on methods of measuring the semantic information acquired from the text. The first and perhaps the most direct method involves obtaining responses from subjects by means of free recall tasks where the subjects are essentially free to organize and restate what they have acquired from the text. This method will require a detailed examination of derived information and the relationship it bears to semantic information explicitly represented in the text. The second program uses such techniques as probe recall, question-answering, sentence recognition, and other methods in combination with reaction time measurements to assess memory structure for text. This program capitalizes on the sophisticated models developed recently for analyzing reaction time measures. The third program involves the development of comprehension "tests" suitable for research applications testing large numbers of children.

(4) As we develop the procedures in the first three programs, we can use them to investigate the manner and extent to which individuals and groups differ in the kind and amount of semantic information they acquire when understanding discourse. This program will examine the variation that exists among individuals across age, linguistic, social, and cultural groups.

(5) We can also use the procedures developed under this approach to investigate developmental changes in the semantic information children acquire from text. Special attention will be given to the order of acquisition of semantic structures. If the developmental changes associated with age can be clearly identified, then we can develop a technology for writing texts which differ in complexity according to the cognitive abilities of children at different age levels.

(6) Finally, the panel thought that it would be worthwhile to examine differences between oral comprehension and reading comprehension. This program will determine in what manner spoken discourse is processed differently from written discourse and in what way knowledge acquired from spoken discourse differs from that acquired from written text.

APPROACH 2.3

EFFECTS OF TEXT STRUCTURE ON DISCOURSE PROCESSING

Approach Statement

Determine how structural characteristics of texts influence how readers process texts and what knowledge they acquire when they understand texts.

Problem Description

Anyone who has tried to put ideas down on paper is probably painfully aware of the fact that most ideas can be expressed in a variety of ways--by a single word, in a phrase, within a sentence, in several sentences, etc. We can present important ideas to readers in a number of different sequences. We may state concepts explicitly, or we may leave them to readers to infer. It is not at all inconceivable that some ways of getting across an idea are easier for readers to understand than others. We can all think of examples of writers whose good insights are almost hidden in a morass of confusing prose.

This approach will investigate the nature of text comprehension and the manner in which text characteristics affect text processing and comprehension. The information gained in this research is likely to be extremely valuable, both to the development of a basic understanding of comprehension processes and to the examination of practical problems associated with the design of textual materials that communicate effectively.

Relevant Research

This approach will continue the focus on text structure and processing as opposed to individual sentences. It avoids the pitfall of assuming that results obtained at the single sentence level will be valid at the discourse level. This approach will make use of the results of the first two approaches in this panel report. It requires the kind of structural model of text that will be produced under Approach 2.1, i.e., a model consisting of (a) a propositional (semantic) base and (b) a grammar capable of generating a text and its paraphrases from a single propositional base. It will also use

the methods produced in Approach 2.2 for assessing the knowledge readers acquire upon reading text. As that approach made clear, "acquired knowledge" includes all information readers acquire when they "understand" a text, whether it is present in the surface structure of the text or whether readers infer it from the text or from its context.

Division of the Approach

We can define discourse structure at several levels: the semantic or propositional structure, the surface structure of individual sentences generated from propositions, and the surface structure which cuts across sentence boundaries, e.g., topical organization, decisions on the sequencing of ideas, and distinctions between old and new information. Because any study of text structure which fails to consider all levels of structure is incomplete, and because these levels interact and influence one another, the panel decided to propose a single, unified research program instead of the several programs characteristic of previous approaches. The program consists of a number of interrelated projects investigating different aspects of text structure, including the effects of making underlying ideas explicit as opposed to implicit; the choice of words or phrases to express concepts; the measurement of how well connected or organized a text is at the semantic level; the definition of "semantic complexity;" and a reinterpretation of "syntactic complexity."

APPROACH 2.4

KNOWLEDGE GROWTH AND USE

Approach Statement

Investigate how linguistic knowledge grows and how readers use this knowledge to understand discourse.

Problem Description

Nonlinguistic contextual factors also contribute to an individual's ability to understand language. The sentence, "May I take your order?" makes sense when spoken by a waitress, while "How many yards of silk do you want?" does not immediately fit. Similarly, if you were approached on the street by a stranger who said, "Bill has a red car." you might have the uncomfortable feeling that you had missed something.

The fact that extralinguistic or contextual factors influence understanding becomes especially significant when we view it from a developmental perspective. Children's first experience with language occurs in social contexts. A great number of contextual cues are always available: the identity of the speaker, spatial and temporal factors, gestures, the objects being referred to, etc. Given this rich context, children can use a very impoverished knowledge of language in order to understand what a speaker means. In fact, one can argue that children may be so responsive to or dependent upon contextual constraints that they rely mainly on them to understand what a speaker intends. They use their understanding of these contextual aids to figure out the meaning of the linguistic utterance and to crack aspects of the syntactic code.

The kinds of contextual aids children encounter in a text, however, are very different from those of the social context they have experienced as accompanying oral language. Children must depend much more on the linguistic message itself in order to understand what the text means. One can view language development as going from dependence upon external, concrete situations to a greater reliance upon abstract, internal knowledge. We would call this process "decontextualization." In order to cope with the formal

language demands of school, children must succeed in decontextualizing. This process may involve the construction of various strategies by which children can interpret what they hear without depending upon extralinguistic context. Children who, for various reasons, have trouble decontextualizing will undoubtedly have problems learning to read.

This approach proposes to investigate the process of decontextualization. The types of skills necessary to understand instructional materials adequately may involve very specialized modes of dealing with language. The ability to understand linguistic information in situations removed from everyday experience may presuppose a particular knowledge of language that can only be shaped in the context of certain activities. Different learners may have had very different experiences, depending on the conditions under which they have used language. The form of their linguistic knowledge may be ideally suited to those conditions, but it may not be suited to the conditions presupposed by formal education tasks or teachers.

Relevant Research

In recent years, research from three disciplines has converged on the idea that understanding involves more than mere linguistic knowledge. In linguistics, researchers have discussed the importance of extralinguistic beliefs and presuppositions in determining the grammaticality of utterances. In the artificial intelligence literature, models of language understanding have had to incorporate knowledge of the world. Psychologists who have manipulated the contextual support for textual passages have found comprehension of text to be profoundly affected by such nonlinguistic contexts. In the field of child psychology, Piaget and other contemporary psychologists concerned with children's language have emphasized the importance of context in children's understanding of language. The research proposed here will build on these investigations.

Division of the Approach

The programs under this approach focus on three areas. The first compares language comprehension in formal (abstract) situations to contextually rich ones. It assesses the degree to which young listeners can understand language in situations that approximate those necessary to learn in formal educational tasks. The second program analyzes the processes involved in decontextualizing, to explore how students develop the ability to make effective use of language in the context of formal educational tasks. The third program focuses on finding techniques for understanding "understanding." There are many ways to facilitate understanding that are intuitively used in social contexts, but are generally absent in written documents. This last program attempts to develop ways to add contextual cues to texts in order to make them more naturally understandable.

APPROACH 2.5

BILINGUALISM

Approach Statement

Investigate the linguistic and cognitive characteristics of bilingual populations.

Problem Description

The educational research on bilingual populations in this country tends to show that bilinguals almost always do more poorly than monolinguals in academic areas. Unfortunately, not much in the way of suggestions for practice and teaching can be mined from the little bilingual research that exists.

Research does, however, suggest that part of the problem may lie in the unique linguistic and cognitive situation of bilinguals. The bilingual person has, at some level, two language-knowledge bases which may operate independently, interactively, or conflictingly. To the extent that they do interact they may create perturbations in either of the language-knowledge bases. To the extent these bases are independent of one another, instruction in only one language may be inadequate; that is, the requisite knowledge base for interpreting the instruction in one language may only be accessible through another, different language.

Common sense suggests that there should be some interaction, but common sense does not suggest whether the interaction will be productive of understanding, especially for children still grappling with the many complexities of language. With the many bilingual-bicultural education programs now underway, the need for research in this area is great. An extension of our knowledge in this area should help overcome the implicit idea of an "educational handicap" and identify functional relationships among bilingual repertories, cognitive styles, instructional patterns, and academic performance.

Relevant Research

Presently, there is little available research concerned with important and large populations of children acquiring two or more

languages simultaneously within the natural environment. Continued research on the structure and meaning of language has concentrated on monolingual populations. It remains to be seen how much of this research is generalizable and relevant to bilingual acquisition.

Division of the Approach

Four programs were identified within this approach.

(1) Research within the first program would attempt to provide a comprehensive linguistic description of bilingual populations in the United States. These basic data should provide the information necessary for a determination of the complexities and scope of the problem area. The data should include information on linguistic differences within bilingual subpopulations.

(2) The traditional model of linguistic investigation (taxonomy of languages) has yielded correlational analyses of language structure with age. We recommend a more direct experimental attitude for the research suggestions in the second program. Such an approach would attempt to go beyond correlational analysis by directly manipulating language parameters in one language while monitoring effects of those manipulations on the other language.

(3) The third program suggests process studies of bilingual persons. Studies of cognitive structures and processes with which bilinguals function would be novel. The information-processing systems bilinguals use and the acquisition of these processes are of both theoretical and applied interest. An understanding of basic cognitive functions might account for performance differences now cited in available experimental reports. We could modify educational strategies as a function of this research.

(4) Sociolinguistic approaches to language acquisition have emphasized the interaction between language and social (cultural) environment. The fourth and final program in this approach suggests research to examine the bilingual person's linguistic and cultural interdependencies during language acquisition. One's implicit knowledge of language, if uniquely associated with social context, may not transfer easily to another linguistic system. Background factors of importance here include patterns of child rearing, different communicative styles, language socialization, selective attention, crosscultural encoding and decoding, the role of silence and/or nonperformance.

APPROACH 2.6

MODELS OF THE PROCESS OF EXTRACTING MEANING FROM DISCOURSE

Approach Statement

Develop models (primarily computer based) simulating the psychological processes involved in extracting meaning from discourse.

Problem Description

The actual processes involved in the understanding of discourse interact in complex ways, too complex for description by theoretical methods such as mathematical or physical models. Not only is the interaction of the processes complex, but information input to these processes can be quite extensive. This complexity and quantity is within the capacity and power of modern computers, however.

Consider the problem involved in understanding a sentence embedded within a larger text. Knowledge derived from the preceding portions of the text, as well as knowledge the subject brings to the text, must be appropriately interfaced and structured as input to processes which parse the sentence and produce the most likely semantic reading. The simulation by hand of such a complex process is unfeasible.

However, the computer allows exploration of the variation and dynamic interaction of such complex processes and their products (here, derived representations of meaning). Often this is the only way to test the consistency and completeness of complicated theories and derive empirical predictions from them.

Relevant Research

Initially the problem of computational handling of natural languages was treated largely as a question of syntactic analysis. In the early years, most work concentrated on developing grammars useful for parsing and generating English sentences. Recently, researchers have shifted toward an emphasis on the problems of semantic representation. Artificial intelligence researchers have realized that they must develop meaning representations consistent with the way people use these representations.

There are some very impressive language-processing programs in artificial intelligence that work in restricted task domains. Many of these programs have achieved their success by very careful analysis of the information-processing demands of their task environment. Algorithms are built which incorporate these demands. However, because the programs are so focused on a particular task they tend to be difficult to extend and thus do not usually contribute to general theoretical development.

We should emphasize the study of processing mechanisms which will generalize to a wide range of phenomena. Generality of the program is of major concern if it is to be a useful predictive device. Newell and Simon's production systems constitute a prime example of an attempt to develop such a general system. This system incorporates memory assumptions based on psychological models and data outside artificial intelligence, and therefore have direct psychological relevance.

The generality and power of a program must be disciplined by the incorporation of considerations about psychological reality. The modern computer is a very general and powerful device but, in itself, offers little of value as a psychological model. Computer models should address themselves to the known body of facts of human language processing. Frequently, the goal of artificial intelligence is to develop programs that can succeed in some task without consideration of their psychological implications. This approach should help promote a more psychological perspective in artificial intelligence research.

Division of the Approach

This approach describes two programs in artificial intelligence:

(1) The first program works on models of the adult competences underlying language understanding. It is realistic to expect that this research will shed considerable light on the role of syntactic, semantic, and conceptual factors in language understanding. Current models are addressing the role of world knowledge and inference-making in language understanding. Models to be developed under this program should, in addition, explore how people use these factors in the understanding of text rather than individual sentences, and pay some attention to sentence-processing time as one indicator of the psychological validity of a model.

(2) Computer work on the acquisition of language is a natural complement to the work on language-understanding systems discussed above. Our linguistic competence is not a fixed capability: Over the years we learn new grammatical styles, new words, and new ways of thinking. To a lesser extent we do the same thing over shorter periods: We adjust our understanding to context. A learning

program is an attempt to incorporate such linguistic pliability into a computer system. Psychological research has developed an extremely rich body of data on semantic and general conceptual factors in language acquisition. However, for all this empirical data, there is a woeful lack of rigorous theoretical analysis. The time is ripe to bring together the computer models of language acquisition and the actual data on language acquisition.

PANEL 3

ATTENTION AND MOTIVATION

APPROACH 3.1: RESEARCH ON THE ENGAGEMENT OF INDIVIDUAL CHILDREN

- Program 3.1.1: Substrates of the Attention Process in Normal and Reading Disabled Children
- Program 3.1.2: Within-Child Variations in Performance and Engagement
- Program 3.1.3: External Influences on Engagement in Reading
- Program 3.1.4: Self-Perception and Engagement in Reading

APPROACH 3.2: RESEARCH ON TEACHER-STUDENT INTERACTION

- Program 3.2.1: Conditions Promoting Student Engagement in the Classroom

APPROACH 3.3: RESEARCH ON THE TEACHER

PANEL 3

ATTENTION AND MOTIVATION

Problem Area Statement

Children staring out the window, perhaps daydreaming of a baseball game, will clearly gain little from the teacher's lesson. This problem is not a trivial one. Teachers armed with the most up-to-date and effective methods for teaching reading still need to maintain and focus the attention of their students.

This panel has explored this problem under the label of "engagement." By "engagement" we mean attention to the task, activity, or teacher, in accordance with the instructions of the teacher, or attention to some spontaneous activity not directed by the teacher but clearly relevant to the overall purpose. The purpose of the proposed set of studies is to identify means by which schools might maximize engagement in learning to read.

We believe that factors of attention and motivation are involved in determining the degree of the child's engagement. Attention refers here to the child's ability to focus on selected pieces of information while ignoring others. Classroom teachers regularly practice attention management; that is, they are regularly concerned with the moment-to-moment manipulation of the flow of information to the children, highlighting intended information and suppressing distractors. Motivational factors presumably allow the children to remain engaged over periods of time, to persist in being effectively attentive. Discussions of the school's role in motivation management seem to center around three levels of responsibility: (1) building enduring positive attitudes; (2) avoiding enduring negative attitudes; (3) making the learning process comfortable. Some educators hold that schools can and should build enduring positive attitudes toward reading; others hold that only family experiences prior to or coexisting with schooling can build these attitudes. Some theorists hold that schools can practice motivational management only to a limited extent, reducing the fear and uncertainty which often serve to impede student efforts to learn to read. All would probably agree that teachers must be concerned with motivational factors to the extent that they can and should arrange to make school instruction as comfortable, pleasant, and reasonable as possible. Taken together, the management of attentional (short term) and motivational (enduring) factors define what we will call engagement management.

Relevant Research

How much can the proposed research on attention and motivation be expected to help? It would be a mistake to assume that teachers do not now manage these factors, or that they do not manage them effectively. A high percentage of American school children do learn to read. Furthermore, since research on teaching generally lags far behind the intuitive knowledge that teachers use in classrooms every day, it would be presumptuous to assume that the research to be proposed will yield results to be taken as prescriptions for teacher behavior. What the research might do is make the processes of creating engagement more explicit, in the service of the following ends:

(1) Less gifted or motivated teachers might be better able to recognize further possibilities of engagement management.

(2) There will be some encouragement for the provision of administrative resources to allow the teachers to act effectively with respect to engagement management in the classroom.

(3) Children now sloughed off as "dumb" or "less competent" may come to be recognized and handled as special problems in engagement management.

Division of the Research

Reading problems are usually identified by observing the child reading or during reading instruction and then attempting to determine the causes of the problems within the children. But the locus of the engagement problem is not inevitably within the child, a problem to be remediated solely by work on the individual. Three kinds of organization intersect to influence children's engagement behavior: (a) their own organized systems of engagement with school; (b) the organization of classrooms; and (c) the organization of teachers' activities which reflects their personal teaching styles and the constraints of the system in which they teach. It seems worthwhile to direct inquiry into all three kinds of organization; thus, the work we discuss will be divided into three kinds of efforts.

The programs of Approach 1 are directed toward studying the motivational and attentional states of children as they take part in schooling. Special consideration will be given to the psychophysiological substrates of attention, to external load factors influencing attention, and to children's conceptions of themselves as learners. Approach 2 contains programs directed toward studying the interactions of children and teachers in the classroom in an attempt to understand the processes that bring about appropriate engagement. Approach 3 involves studies of teachers and the system within which they work.

APPROACH 3.1

RESEARCH ON THE ENGAGEMENT OF THE INDIVIDUAL CHILD

Approach Statement

Investigate psychophysiological and environmental factors affecting the engagement of individual children, and the relationship between their understanding of themselves as learners and their engagement in reading-related tasks.

Problem Description

The hypothetical student found staring out the window may be doing so for any number of reasons. There may in fact be a baseball game going on outside which is distracting; the child may be worried about understanding the lesson, or may see the lesson as irrelevant. The student may be influenced by a natural biological cycle tending toward greater attentiveness at some times and less attentiveness at others. There are numerous other possible explanations. Obviously, if a teacher is to help this child, it is important to understand exactly what the problem is.

Relevant Research

Research under this approach will consider those attentional and motivational factors which affect the classroom performance of children at different age levels. So far, developmental psychology has been linked to education mostly through the assumption of a relationship between cognitive development and the substance of school curriculums. There is now good reason to believe that performance factors change with age fully as much as intellectual competence factors, and that "school readiness" involves both cognitive and performance factors. Research under this approach should provide more rational premises for classroom scheduling and management and for the design of remedial environments for students who have special difficulties with reading.

Division of the Approach

The approach is divided into four major programs of research.

(1) There are often claims that reading-disabled children show "abnormal" EEGs. However, we have no good data base to support these claims; there is presently little information on the qualitative and quantitative nature of such an "abnormality." The technology to build such a data base, however, does exist. Within the last decade, research in the neurosciences has progressed enormously. With the advent of biotechnology it has become possible to look at psychophysiological functions and their behavior concomitants. We have gained a great deal of knowledge about the mechanism of adult learning, attention, motivation, and emotion, but we have precious little data about the development of these mechanisms.

The principal aim of this program, then, is experimental analysis of the influence of attentional factors on information processing in reading-disabled children. The first projects would attempt to identify relevant electrophysiological and psychophysiological correlates of signal detection, set, and attention. The EEG and the new methods of quantitative analysis are particularly sensitive measures of biological rhythms and states of arousal and vigilance. Since we know very little about developmental changes in the generalized EEG spectrum, and nothing about the relation (if any) between developmental changes in EEG and corresponding developmental sequences of skill acquisition or cognition, these studies must be considered fairly basic. Nevertheless, a finding that differences between the normal reader and the disabled reader do exist in this area would generate useful working hypotheses about developmental lag and neural organization in this group.

Subsequent proposed studies in this section emerge from consideration of some simple models of information processing and memory, and involve a research strategy which may enhance our knowledge of specific processing problems in reading-disabled children.

(2) The second program focuses on the regular and explainable variations of activity level and performance within children. These variations can be expected to interact with the formal constraints of the classroom schedule and activities. The schedule of the school day invokes regularized shifts in the behavioral constraints placed on children. Shifts in behavioral expectations occur when a class as a whole moves from one set of activities to another; for example, from reading to recess. Thus, the school is organized into alternating periods of rest and activity.

The careful assessment of regular cycles in performance and an estimate of their impact on school-related tasks could have important implications for scheduling school activities. A finding that individual children (or identifiable subgroups, such as those with learning problems) show cycles of performance not in phase with the cycles of their classmates could help to explain some of the observed within-child variations in performance efficiency shown by some children now categorized as learning disabled.

Natural cycles of activity level and performance are known to exist in many areas of adult behavior, with performance on such tasks as reaction time, vigilance, time estimation, and others showing regular variations over the course of a day. The extent to which these (or other) fluctuations in performance may be found in young children remains relatively unknown, though there are reasons to suspect that the effect of biological rhythms on performance may be more pronounced in children than in adults.

Several projects to investigate variations in electrophysiological measures (which may in turn serve as indexes of basic attentional levels) have been outlined in the previous program. The present program is concerned with observable behavioral manifestations of endogenous factors, stemming from within the child, which help to determine the observable level of performance.

(3) In addition to internal cycles, there are environmental influences, labeled "external load factors," which affect children's engagement in school-related tasks. By external load we refer to factors that detract from the full employment of the cognitive structure available to the individual. These would be, generally, (a) the presence of environmental noise--in the instructions or the environs of the task--thus requiring signal processing; (b) the presence of task properties which may be unfamiliar or distracting, and (c) the presence of multiple agenda in the task situation, circumstances that require children to divide their attention, at times making adjustive cognitive, social, or mood-tension shifts. A fundamental concept is that we can begin to approximate an understanding of the operating characteristics of children's behavior in the classroom by first understanding their natural competence and then successively reinterpreting our understanding in light of the various demands placed on children within a classroom.

There exists a vast literature on testing format as a load factor affecting performance. These studies span many aspects of cognitive ability. The effect of load factors on problem solving, particularly on Piagetian tasks, has been studied extensively. Similar studies concern performance-competence in perception, memory, language, and attention. There is a need to evaluate this literature systematically in order to arrive at an orderly understanding of load factors.

There have been few investigations, however, which systematically examined the effects of load on student performance. Most studies in this area have focused on isolated variables, and have also been conducted in settings artificially abstracted from behavior in classrooms. If such studies are to add to our understanding of the engagement process in the classroom, they should examine the effects of these load factors on the engagement behavior of children in natural settings.

(4) Beginning with Piaget's interest in "reflective operations" and continuing with present American work on metacognitive and metalinguistic awareness, there has been increasing interest in children's theories of their own learning and knowledge. There is good reason to believe that, beginning about the time children enter school, they begin to dimensionalize the physical and social world that surrounds them. Since school is so large a part of children's lives, it is likely that a significant aspect of this movement is the development of an idea of what school is all about and what their own places and possibilities in the schooling process are. This program will attempt to study the relationship between children's conceptions of their cognitive abilities and role in the schooling process, and their engagement behavior in the classroom.

This work develops a facet of Piagetian theory that was left behind in the first wave of acceptance of genetic epistemology. It is central to Piagetian theory that structured knowledge about one's own acts or operations must develop at roughly the same pace. Children gradually develop concepts of the nature and scope of their own activity. They attempt to speculate not only about the world around them but about themselves and their role in what they experience. They build a theory of the self.

Since school is a major aspect of children's experience, one would expect that they have a conception of what part they play (and should play) in the system. Further, it is likely that these self-perceptions direct children's classroom behavior. If such a relationship is established, it will be valuable to investigate whether particular facets of classroom structure seem to be regularly associated with certain student attitudes (e.g., the unstructured classroom may be more likely to promote self-confidence than the highly structured classroom). The practical implications for attentional management in the classroom are obvious: If student self-perceptions with respect to school are related to classroom engagement behavior, then teachers must attempt to create an environment which promotes the development of healthy self-perceptions.

APPROACH 3.2

RESEARCH ON TEACHER-STUDENT INTERACTION

Approach Statement

Study the relationship between teacher-student interactions and student engagement in the classroom.

Problem Description

Approach 3.1 focused on those characteristics of the student that enhance or detract from classroom engagement. In this section we consider studies of classroom processes (of the interaction of student and teacher) as they affect student engagement.

Common sense tells us that the styles, rhythm and purposefulness of students in a classroom can be positively influenced and directed by the teacher's instructional strategies in presenting material and in student/teacher interactions. We assume that children differ in terms of the teaching environments they learn best in. We also assume that individual children will vary within and among days in their usage of specific teaching environments. Therefore, the problem for research becomes one of identifying the resources and arrangements that teachers can use to make individualized "moves" based on their evaluations of particular children. The problem for research is also one of identifying strategies for successfully estimating the engagement state of a given child.

Relevant Research

Clearly, many teachers already practice attention management. They already take into account the kinds of factors being considered here. Some manage very well, though often unconsciously. What research can do is make the process of attention management more explicit and somewhat more systematic.

We suggest here only one program of research on classroom processes. Other planning activities of the NIE have focused extensively on the analysis of teaching and teacher-student interactions (see in particular the 10-panel series of reports from the

NIE Conference on Research on Teaching). The particular focus we suggest is descriptive--we are concerned with the way in which teacher behaviors, classroom activities, and the content of reading instruction relate to student engagement.

Both attentional and motivational management of students are critical to the successful teaching of reading. As instructional strategies become more diverse through the adoption of various models of classroom organization, teaching styles, and approaches to the teaching of reading, the variation in the ways teachers orchestrate the flow of activities and information within classrooms increases. Descriptive data portraying the successful and unsuccessful attempts of teachers to promote engagement in different settings should provide: (a) hypotheses for future experimental interventions in the classroom and (b) insight into the theory and nature of individual processes that control engagement.

Division of the Approach

We suggest five projects. The first calls for an overall accounting of the amount of time and variation in time that teachers spend in engagement management and in direct instructional activities. This research should give us a base of information for assessing the data generated from the other four projects. These projects in turn call for analysis of the consequences on student engagement of variations in instructional settings, teacher behaviors, classroom activities, and the timing and pacing of teacher behaviors.

APPROACH 3.3

RESEARCH ON THE TEACHER

Approach Statement

Investigate the antecedents of, and the continuing influences on, teacher behaviors in the classroom which influence engagement.

Problem Description

The preceding approaches were directed toward studies of processes within children and within the classroom. The present approach offers selected projects dealing with studies of teachers and teacher roles as they influence learning to read. In addition, we discuss the development of an evaluation instrument for classroom engagement.

Relevant Research

As explained in Approach 3.2, we have no desire here to enter into extensive research planning on teachers and teaching. Our suggestions in this area are limited to the suggestion of five thematic issues extending from the previous analyses and having implications for work at this broader level.

Division of the Approach

(1) One could reasonably expect that teachers' attitudes will affect teacher behaviors and classroom management techniques. Knowledge of teacher attitudes is therefore of considerable importance. We suggest studies of the teacher's role in creating classroom engagement that reflect a developmental analysis of teachers and their understanding of their role. The panel, in discussing teachers, came to adopt the view that the teacher, like the child, must be regarded as developing and changing. We generally talk of teachers in fixed terms--as people with definite styles, traits, abilities, knowledge, training, etc. But it seems likely that adopting this view of teachers is as simplistic as making a similar assumption about children.

(2) After identifying regularities in teacher attitudes which may correspond to different phases of teacher development, it would then be possible to attempt to identify teacher behaviors associated with particular attitudes. If we demonstrate a relationship between teacher attitudes and teacher behaviors, then an additional strategy for optimizing student engagement may be to focus on the development of optimal teacher attitudes (possibly through teacher training, and/or teacher support systems).

(3) It would be interesting to conduct observations of activities in the classroom and relate this information to teachers' perceptions of what happened during this time period. A comparison of teacher ratings of classroom activities with observations of actual classroom activities would provide an index of the accuracy of teachers' perceptions.

Such an index may prove useful for at least two reasons. First, it could provide teachers with information about actual classroom activities. For instance, a teacher may overestimate the amount of time that students are actually engaged in reading-related tasks, and may therefore want to adjust teaching strategies accordingly. Second, the accuracy of teacher perceptions may be one factor differentiating between successful and unsuccessful teachers with respect to their ability to stimulate classroom engagement. For example, teachers of students showing high engagement may be more aware of the fluctuations in the level of student engagement with the changes in classroom agenda than less successful teachers. If this awareness proves to be the case, it may be beneficial to devise teacher training programs which attempt to improve the teacher's skill in assessing the levels of student engagement in the classroom.

(4) Research within this program would focus on the relationship of teacher performance cycles to student engagement in the classroom. If we can identify regular cycles in teacher performance, then it would be interesting to compare these fluctuations with observable student engagement cycles. Approach 3.1 focused on identifying such cycles in children. One might expect that periods of high student engagement would coincide with periods of high teacher effectiveness. It is possible, however, that these cycles may not coincide because of scheduling and other school constraints.

One major undertaking of this investigation would be to determine if periods of reading instruction are (and should be) scheduled at times of optimal teacher effectiveness. If student and teacher cycles coincide, then it would seem that reading periods should be scheduled accordingly. If the cycles do not coincide, on the other hand, it would be necessary to consider possible trade-offs between optimizing teacher effectiveness and optimizing student engagement.

(5) Teachers and principals regularly make short-term judgments about the effectiveness of various teaching strategies. Whether or not we have a science of evaluation, there is certainly a regular

practice of evaluation in schools, and it is likely that these evaluations show a reasonable degree of reliability. It is also likely that these evaluations are a result of intuitive estimations of three basic factors: (a) whether classroom organization, discipline, or control exists; (b) whether there is engagement on the part of the students; and (c) whether effective teaching is going on, as estimated in some cases by criterion-referenced judgments.

It would seem useful to conduct a series of studies in which an engagement index is compared to other measures of the effectiveness of classroom instruction (e.g., criterion-referenced tests of achievement). Routines for constructing and validating standardized tests are well known and could be applied to constructing an engagement index. If such an index were repeatedly successful, it might achieve a degree of standing as a valid measure of educational quality. Assuming partial validation of an engagement index, there would seem to be a multitude of classroom applications.

PANEL 4

MODELING THE READING PROCESS

APPROACH 4.1: DEVELOPMENT OF A MODEL FOR WORD RECOGNITION DURING READING

- Program 4.1.1: Determination of the Relevance of Tachistoscopic Studies of Letter and Word Recognition to Reading
- Program 4.1.2: Determination of What Visual Information in the Letter String the Reader Uses in Word Recognition
- Program 4.1.3: Determination of How Orthographic Structure Facilitates Word Recognition
- Program 4.1.4: Determination of How Syntactic and Semantic Context Contribute to Word Recognition
- Program 4.1.5: Determination of Whether Phonological Mediation is Necessary for Word Recognition
- Program 4.1.6: Determination of What Kind of Long-Term Memory Storage Units are Necessary in Letter and Word Recognition

APPROACH 4.2: INVESTIGATION OF THE INTEGRATION OF WORD MEANINGS INTO HIGHER ORDER STRUCTURES

- Program 4.2.1: Determination of How the Reader Integrates Word Meanings into Higher Order Semantic Structures
- Program 4.2.2: Determination of the Temporal Course of Comprehension in Reading
- Program 4.2.3: Determination of What Role Inner Speech Plays in Reading

APPROACH 4.3: CHARACTERIZATION OF THE DEVELOPMENT OF READING ABILITY IN CHILDREN

- Program 4.3.1: Empirical Verification of Which of the Methods Used in Determining Reading Processes in Adults are Valid for Children
- Program 4.3.2: Determination of Which of the Components of the Reading Process Postulated for Skilled Adult Readers are Operative in Children
- Program 4.3.3: Examination of the Role of Instructional Histories in the Development of Children's Reading Skills

Program 4.3.4: Identification of the Differences Between Good and Poor Readers with Respect to Processing Components

Program 4.3.5: Examination of Those Behaviors Observed in the Learner but not Generally Observed in Skilled Readers

APPROACH 4.4: DEVELOPMENT OF A MODEL FOR EYE-MOVEMENT GUIDANCE DURING READING

Program 4.4.1: Determination of How Accurately the Eyes Can be Moved in a Saccade

Program 4.4.2: Determination of How Long Subjects Need to Integrate Visually Presented Information and Move Their Eyes on the Basis of That Information

Program 4.4.3: Determination of What Types of Information can be Resolved at Different Points in the Periphery

Program 4.4.4: Determination of How Much Visual Information can be Resolved in the Periphery with Unlimited Processing Time

Program 4.4.5: Determination of How Much Information About the Spatial Properties of the Text is Available to Readers for Guiding Regressive Movements

Program 4.4.6: Determination of Whether Readers can Resolve Meaning and Simultaneously Decide Where to go Next

APPROACH 4.5: MEASUREMENT OF THE INFORMATION-PROCESSING HABITS OF COMPETENT READERS WHEN THEY ARE CONFRONTED WITH COMPLEX READING TASKS

Program 4.5.1: Development of a Measure of Information Load for Short Texts

Program 4.5.2: Measurement of Reading Behavior for Texts of Varying Information Load and for Varying Required Recall Criteria

Program 4.5.3: Determination of the Accuracy with Which Readers can Return to Previously Read Materials in the Immediate Reading Task

Program 4.5.4: Determination of the Effect on Accuracy of Recalling Nonverbal Information in a Text

PANEL 4

MODELING THE READING PROCESS

Problem Area Statement

The recommendations of this panel are an attempt to gain, through systematic and precise means, an understanding of fundamental processes involved during reading and of the interrelationships among the processes. This panel thus placed a special emphasis on what is being investigated, i.e., reading processes, and on methodology, a combined experimental-theoretical approach they refer to as "modeling."

The former emphasis is a logical next step for present research to take. Our present ability to isolate causes of reading failure is limited to such behaviors as blending, word recognition, getting the main idea, and so on. These behaviors have to date remained inscrutable. The details of the processing that must, by definition, attend these behaviors are still unknown.

Not only is the examination of reading processes a logical next step for research, it is an important step for reading remediation as well. First, an understanding of the fundamental processes in reading is essential for evaluating current teaching and testing practices. Second, such understanding can also lead to the construction of improved strategies for diagnosis and intervention.

The second major emphasis in this panel, the emphasis on modeling, is not an idle gesture. The nature of the phenomena being examined dictates a certain approach to the study. Processes interact in complex ways. A putative explanation of the processes must therefore account not only for the processes themselves, but for the significant interactions that take place between the processes. In one sense, then, modeling can be looked upon as an umbrella term for an approach which involves attempting to model, simulate, or describe the complex phenomena at hand.

The types of model that this panel endorses are those that posit component processes or stages (but not necessarily discrete stages) and attempt to describe forms of information involved at each stage. A model should generate testable hypotheses. In this sense, a good model for a reading process is one which leads to its own destruction in a hurry; that is, leads to experiments which themselves produce data for building an improved model.

Relevant Research

The absence of any discussion of the complete models for the reading process published in the last 10 years is intentional. It is our opinion, after extensive analysis of such models, that too little is known about the various components of the reading process to justify attention to complete models. Where advances appear to have been made in understanding the reading process, they come from narrowly delimited areas in which models can be easily constructed and thoroughly tested.

The development of a model of the reading process clearly would have important practical benefits. A processing model, in its attempt to define operations and relationships among components in testable terms, allows the definition of potential points for diagnosis of reading difficulties. Whereas methods of diagnosis and instructional intervention would remain to be developed and tested, the study of component processes in reading can serve as a foundation for such practical research.

Division of the Research

Our primary goal was to prepare a programmatically related set of suggestions which would lead to a clearer account of the reading process. The actual problems the panel chose for examination are those which have persisted in the psychological and education literature. The choice reflects the hope that an information processing approach can resolve some of these long-standing controversies.

Specifically, model-oriented research was suggested in five areas which were judged to be especially amenable to such an approach. The first two approaches involve developing models of word recognition and of higher order comprehension processes in adult readers. The third approach involves modeling reading ability as it develops in children and of crucial importance to the design and evaluation of both instruction and diagnosis. As yet this approach has received little systematic attention from psychologists or educators. The last two approaches focus on two problems for which the methods used in eye-movement research are appropriate--the development of a model for eye-movement guidance during reading and a model of "careful reading" of complex reading materials.

APPROACH 4.1

DEVELOPMENT OF A MODEL FOR WORD RECOGNITION DURING READING

Approach Statement

Develop a model for word recognition during reading.

Problem Description

For skilled readers, word recognition seems automatic; it is difficult to determine through introspection precisely what factors are involved when one recognizes a word in text. Yet an understanding of this process is basic to the eventual understanding of the reading process and to the design of effective instructional methods and diagnostic instruments.

A number of factors seem critical to the recognition process. There are of course the most obvious factors--visual appearance of the letters themselves and spelling. Other factors may be equally important. Impressions of a word appearing in peripheral vision may facilitate actual recognition of the word. Syntactic and semantic context may play an important role. Several investigators have suggested that phonological mediation is necessary.

Relevant Research

Studies on word recognition comprise the major portion of the experimental literature related to reading. Thus there is no dearth of relevant research. However, the studies have employed a variety of different paradigms or models. The research programs this panel suggests should consider the place of a component process within the larger whole. Our emphasis on an information-processing approach gives some guarantee that there will be such consideration.

Division of the Approach

Six issues of obvious importance stand out in the word recognition literature: the relevance of tachistoscopic studies of word and letter recognition to reading; the identification of that visual information in the letter string readers use for word recognition; the effect of orthographic structure on word recognition; the effect of syntactic

or semantic context on word recognition; the contribution of phonological mediation to word recognition; and the description of the long-term memory storage units necessary in word and letter recognition. Each of these issues constitutes a program research recommendation.

APPROACH 4.2

INVESTIGATION OF THE INTEGRATION OF WORD MEANINGS INTO HIGHER ORDER STRUCTURES

Approach Statement

Investigate the integration of word meanings into higher order structures.

Problem Description

In the information processing approach we propose, reading involves the successive recognition of larger and more abstract meanings. Processing does not end at the level of word recognition; in fact, by the time they have finished reading a text, readers can rarely remember many of the specific words and phrases they have read, even though they have no trouble discussing the overall meaning of the text. Readers must integrate the meanings of words in order to understand phrases and sentences. Presumably, the meanings garnered from successive sentences are built into a broader understanding of the paragraph or story as a whole.

Relevant Research

The process of meaning integration is as yet undefined. The procedures and knowledge base for this research are not as well-developed as those for research on eye-movements and word recognition. In fact, it is difficult to define the issues clearly. Readers do appear, however, to have available to them a store of knowledge and experience built up over a lifetime to aid in comprehending a text. They also appear to have a variety of different strategies they can apply in obtaining and retaining meaning. We are only now beginning to find promising models for the information content of texts or conversations, and for the ways in which information is acquired from text and stored in long-term memory.

Division of the Approach

Inasmuch as Panels 1 and 2 focused on these issues to a greater extent, we refer the reader to their reports for a comprehensive

research program. This panel did, however, delineate three programs which seemed especially appropriate for investigation through a modeling approach:

(1) It seems unlikely that readers can recognize higher order meaning units, such as sentences, in the same direct way that they recognize words. This program will attempt to determine what syntactic and semantic processing must occur after word recognition in order to integrate word meanings into higher order semantic structures.

(2) Recent research on the temporal course of sentence comprehension has suggested that grammatical and/or semantic units may be processed as units. This program will pursue the research in this area in order to determine the temporal course of comprehension in reading.

(3) Studies have shown that subvocalization increases when the perceptual or cognitive load in reading increases. This program will investigate this phenomenon in order to determine what role inner speech plays in reading.

APPROACH 4.3

CHARACTERIZATION OF THE DEVELOPMENT OF READING ABILITY IN CHILDREN

Approach Statement

Characterize the development of reading ability in children.

Problem Description

Knowledge of the development of certain reading skills could have potentially important implications for instruction. Yet few attempts have been made to construct models to account for the development of eye movements, word recognition and integration skills that fluent readers evidence. It is not in fact all that surprising to find so few attempts. In some cases the construction of models has not been feasible, given current knowledge of cognitive, memorial, and language-processing skills, especially for children in the important 8- to 12-year age range. In other cases, the construction of models awaits a more adequate understanding of adult skills.

Relevant Research

Given these reservations, the panel concentrated its recommendations on studies which attend to the reading processes of skilled readers. The five major recommendations related to developmental models are concerned for the most part with the gathering of basic information from which developmental questions could be derived.

Division of the Approach

(1) The first research program within this approach would seek to verify empirically which methods used in studying adult reading processes are valid for children. Such an effort would contribute not only to an eventual characterization of reading development, but also to the comparison of groups in terms of instructional methods and cognitive styles.

(2) A determination of which of those components of the reading process postulated for skilled adult readers are operative in children

would constitute the bulk of the second research program. Of particular interest to this panel would be the investigation of the importance and function of regressive eye movements, the use of orthographic and syntactic or semantic context in word recognition, and the temporal course of the integration of word meanings into higher semantic units.

(3) The third program would examine the role of instructional histories in the development of children's reading skills. It is worth speculating whether or not learning to read can be considered independent of instruction. The developmental view that emphasizes cognitive and linguistic growth depending on internal maturation and rule construction would suggest that specific sorts of instruction impinge on learning to read in only a remote way. It is clearly important that instruction and development, when they do dovetail, overlap in constructive ways.

(4) The development of the reading process in children who are poor readers needs examination. The fourth program would identify differences between good and poor readers with respect to processing components. The findings could be used to assist in diagnosis and remediation and would also serve to test the generalizability of the model developed for successful readers.

(5) The final research program would examine behaviors which are observed in learners, but which are not generally observed in skilled readers. This research has important implications for both assessment and theory. There seems little need to require students to maintain a skill which no longer serves a useful function. Assessment batteries are not always constructed with this fact in mind. If we found that continued use of a skill, at one time facilitative, actually hampered further development, this might have important implications for learning theories.

APPROACH 4.4

DEVELOPMENT OF A MODEL FOR EYE-MOVEMENT GUIDANCE DURING READING

Approach Statement

Develop a model of reading which accounts for the guidance of the eyes' movements during reading.

Problem Description

To say that readers move their eyes in order to read seems to be stating the obvious. No one would argue that we do not move our eyes across a page--sometimes looking back to what we have read, sometimes skipping forward--in order to derive whatever meaning we can. How we move our eyes, however, is not so obvious. Readers may move their eyes deliberately, on the basis of what they have read and what they can see in the periphery; or the eyes' movement may be constrained physiologically in such a way that they move across the page at a fixed rate. Current models of eye-movement guidance fall on both sides of this question; empirical data is insufficient to support conclusively either type of model.

Models of eye-movement guidance positing voluntary control of eye-movements view reading as analogous to picture or scene scanning. As in picture processing, these models assume that readers move their eyes on the basis of what they have already seen and what looks interesting in peripheral vision. In the other class of models, however, the eyes move at a relatively constant and fixed rate, serving to place each word of the text in foveal vision for a brief period so that it can be seen clearly.

Models that assume that the eyes are guided voluntarily from fixation to fixation, however, require experimental support for a number of assumptions. The following are examples of those assumptions that need to be proven: (1) the eyes can be guided accurately to a particular location in a text; (2) the information obtained in one eye fixation can be resolved soon enough to be used in determining the location of the next fixation; (3) readers can resolve sufficient information from the periphery to locate succeeding fixation points;

(4) readers retain sufficient information about the visual properties of the text to guide regressive eye movements; (5) readers can simultaneously integrate the meaning of what they have just read and guide the eyes on the basis of this information and/or on the basis of information available in the periphery.

Relevant Research

The movement of the eyes has been studied extensively since the latter part of the nineteenth century. In 1879 Javal established that the eyes move in jerks or saccades, with information coming in only during the fixation pauses. Studies beginning with Judd and Buswell in 1922 have investigated the eye-movements of readers of all ages reading material of different complexities. More recently, computer-controlled eye-movement monitoring has led to renewed interest in measuring eye-movements and in analyzing the ability of readers to process information from different points in the visual array.

This approach should incorporate a number of experimental methods. Although many of these studies require the monitoring of eye-movements in reading, they also require analysis of the subprocesses in isolation in order to assess processing limitations. For example, we can use tachistoscopic studies to define how much visual information readers can resolve in a single eye-fixation or how much information is actually available in the periphery.

Division of the Approach

The approach is divided into six programs that focus on discovering the extent to which readers can voluntarily guide the eyes during the reading process. The first program will determine how accurately readers can move the eyes in a saccade. The guided eye-movement model assumes that readers can select a particular point in peripheral vision to fixate on, such as the first letters of an as yet unidentified word. This program will determine how accurately readers move their eyes in a single saccade to a designated point. This research will establish an upper limit on eye-movement accuracy. The next three programs examine the use of information available at the fixation point and in the periphery. The fifth program will determine how much information about the spatial properties of the text is available for the readers' use in guiding regressive eye-movements. The last program will determine whether readers can simultaneously resolve meaning and decide where to go next. The guidance model assumes that readers can guide their eyes on the basis of what they have just read or what they see in peripheral vision. Thus, in the period of roughly 1/4 of a second, the eye-movement decision has to be made and the eye-movement initiated. Experiments under this program will test whether skilled readers and beginning readers do have the capacity to read in this manner.

APPROACH 4.5

MEASUREMENT OF INFORMATION PROCESSING HABITS OF COMPETENT READERS

Approach Statement

Develop procedures for measuring the information processing habits of competent readers when they are confronted with complex reading tasks.

Problem Description

The skills competent readers bring to a reading task seem to vary according to the demands of the task itself. For light information loads, or for tasks in which readers are not concerned with complete or nearly complete processing of ideas or facts, reading may be composed of predominantly forward-going eye-movements. However, the form of reading that appears to place the greatest processing demands upon readers is called, for lack of an agreed-upon label, careful reading. It is the process by which competent readers gain recallable information from complex texts. As integration and recall demands increase, readers move backward and forward, taking in new materials and returning to previously scanned parts as they discover that they need to reexamine them. In some cases subvocalizations may be involved.

This form of reading probably predominates for almost all subject matter children encounter in their schooling. Indeed, it seems to be the most effective method for extracting meaning from complex reading materials. The combination of skills used in careful reading, however, is not taught in school. The popular idea of reading is as a forward-moving process with only occasional regressions. It seems that the combination of skills used in the careful reading process would be a useful set of skills for reading instruction to teach. This approach will attempt to lend empirical support to our intuitive ideas of the processes involved in careful reading. If such a combination of skills does exist, then it should be a welcome addition to a poor reader's repertoire.

Relevant Research

Research on careful reading is scanty. It is interesting to note that most eye-movement research ignores careful reading, partly because of difficulties in tracking vertical movements of the eyes. We do not even have an adequate term for the rereading of words or phrases when the rereading is not due to immediate recognition or integration problems.

Division of the Approach

There are four programs of research proposed under this approach. The first will develop techniques necessary for analyzing careful reading behavior: A measure of information load in texts, a procedure for tracking the kinds of eye-movements typical of careful reading. The second program will use these techniques to measure reading behavior under varying information-load and recall criteria. The last two programs investigate two other aspects related to careful reading which are of interest: The accuracy with which a reader can return to previously read information in a text and the effect on accuracy of recalling nonverbal information (such as presence of italics and page configuration) in a text.

PANEL 5

ASSESSMENT OF READING COMPREHENSION

APPROACH 5.1: ANALYSIS OF THE READING DEMANDS IN AMERICAN LIFE

Program 5.1.1: Analysis of Functional Reading Tasks

APPROACH 5.2: IDENTIFICATION OF PSYCHOLOGICAL FACTORS INVOLVED IN READING COMPREHENSION

Program 5.2.1: Information-Processing Models for Selected Reading Tasks
Program 5.2.2: Use of Previous Knowledge in Obtaining New Information from Reading Material
Program 5.2.3: Message Characteristics
Program 5.2.4: Comprehension Processes

APPROACH 5.3: EVALUATING INDIVIDUAL PERFORMANCE AND INSTRUCTIONAL OUTCOMES

Program 5.3.1: Assessing Various Kinds of Comprehension
Program 5.3.2: Domain-Referenced Tests of Reading Comprehension
Program 5.3.3: Diagnosing Individual Deficits in Comprehension and Their Remedies
Program 5.3.4: Determining the Content and Effectiveness of Higher Level Reading Instruction

APPROACH 5.4: COMPREHENSION AND THE DESIGN AND EVALUATION OF WRITTEN MATERIAL FOR EFFECTIVE HUMAN USE

Program 5.4.1: Techniques for Determining the Comprehension-Relevant Characteristics of Specified Populations
Program 5.4.2: Determining Difficulty and Other Demand Characteristics of Written Material
Program 5.4.3: Systems, Methods, and Aids in Preparation of Special Purpose Written Material

PANEL 5

ASSESSMENT OF READING COMPREHENSION

Problem Area Statement

The term "reading comprehension" has come to mean many things. Any systematic approach to the assessment of reading comprehension must select from the wide range of possibilities and explicitly delineate and describe the nature of the performances considered to imply reading comprehension. These explicit descriptions in essence become working definitions of reading comprehension. These working definitions should capture socially important aspects of the use of written materials. They also should provide palpable and realistic domains of phenomena for the theorist and experimenter to attempt to understand and explain.

The approach to assessment of reading comprehension which this panel favors involves looking at the many practical uses of written material as sources of those performances we wish to identify with comprehension. However, we do not wish to restrict ourselves exclusively to tasks derived from an analysis of social and practical demands. We do not see reading comprehension as a single process that needs to be explained. Rather, reading comprehension entails many different performances involving many different kinds of written material. Each may need a different model and may be affected by different factors, although we hope that some general conceptual model will prove possible.

The view of comprehension we propose does not look to the written material for the primary index of the appropriateness of comprehension. We do not view reading comprehension only as a process of extracting the "true" content of a message. We believe we can avoid serious logical and practical difficulties by using some referents outside the written document to determine whether readers have achieved adequate comprehension. These outside referents, for example, may demand purely verbal performances such as answers to questions derived from instructional goals, or they may involve some other activity such as assembling a bicycle.

Relevant Research

Scientific research on reading began at the end of the last century. Despite considerable work, the accumulation of systematic knowledge in this area has been slow. The scientific analysis of reading has been difficult because reading appears to depend on many

interrelated human capabilities, such as thinking, learning, and perception. Each of these in turn is imperfectly understood. Other sources of difficulty have been the lack of explicit descriptions of reading activities, lack of exact measurement techniques, and lack of productive theoretical models.

During the past decades, several developments have taken place that bear on future reading research. Among these developments are more powerful methods for characterizing readability and the development of criterion-referenced achievement tests. Failures in machine translation and difficulties in applying the concepts of transformational grammarians to language behavior have taught us about the importance of semantics and about the folly of treating "understanding" as if it were a primitive term requiring no further definition.

Division of the Research

The first approach seeks to characterize the domain of reading skills by examining the literacy demands of school, personal life, occupations, and society. The second analyzes the psychological demands of various uses of written documents through a detailed task or process analysis in which the reading activity is examined in great detail. We will also make an attempt to translate the results of these analyses into more fundamental terms, to relate them to hypotheses about the underlying processes involved. Approach 5.3 builds on the results of the previous approaches to design assessment instruments appropriate to diagnose individual reading problems and to evaluate instructional programs. Similarly, Approach 5.4 uses the results of the first two approaches to establish guidelines for the design of comprehensible written materials.

APPROACH 5.1

ANALYSIS OF THE READING DEMANDS IN AMERICAN LIFE

Approach Statement

Determine the nature of reading tasks in various school, occupational, and personal situations so that instructional systems, reading comprehension measures, and scientific studies of the reading process may more faithfully reflect the nature of reading as it actually occurs in American life.

Problem Description

What do individuals have to know to make effective use of the written material they will encounter? Presumably, the answer to this question is precisely what reading instruction in the schools is designed to teach and what comprehension tests are designed to test. Unfortunately, much evidence exists to suggest that reading curriculums and the tests constructed for them do not adequately represent the world outside the school. Hence they are incapable of properly preparing students for full participation in society. Similarly, assessment instruments do not now tell us how well students are acquiring functional reading skills useful to them in later life.

The research proposed in this approach will provide the information needed to construct instructional systems and tests of reading comprehension which are fully representative of the uses of reading materials both within the school system and in the greater society. To accomplish this goal, it is necessary to determine in considerable detail the various uses of written material and the practical and personal demands society and cultures make on various individual members in the use of these materials. However, limited availability of funds forces a narrowing of interest from the domain of all possible reading tasks to a subset of those tasks of a more pragmatic functional nature. Therefore, the single program included within this approach focuses on reading tasks performed for educational, occupational, or other practical reasons. This focus reflects the judgment that performance of such functional reading tasks is of more immediate concern to

individuals seeking satisfactory lives in our society, and to the society which bears the economic burden of preparing future generations to contribute to the general welfare of the society.

Relevant Research

We propose that task analysis techniques be used to analyze the literacy requirements of sampled reading tasks. Because of the unmanageably large number of settings for reading tasks, it is necessary to divide the settings into representative domains (e.g., occupational reading tasks) and then into job clusters prior to sampling. Fortunately, there has already been some research to prepare the way for more comprehensive projects to identify functional reading tasks.

Methods for task analysis have been fairly thoroughly worked out by applied psychologists in industry and in the Departments of Labor and Defense. These procedures permit a determination of the types of reading materials in various settings; the uses for the materials; the importance of various reading tasks; the frequency of reading tasks; the differences between reading tasks for entry and for advancement through job levels; and the differences between reading tasks for learning a job as opposed to doing a job. Modification and refinement of existing task analysis procedures will be necessary to extend these procedures to nonoccupational settings.

Division of the Approach

This approach consists of four main projects. The first identifies the important functional reading tasks required by American life. The second project scales those tasks for difficulty. The third determines the reading difficulty requirements of selected domains of American life. The last project initiates task analyses of the more important uses of written materials by describing the conditions of each particular reading task in sufficient detail to permit and stimulate its detailed analysis as a psychological process.

APPROACH 5.2

IDENTIFICATION OF PSYCHOLOGICAL FACTORS IN READING COMPREHENSION

Approach Statement

Identify the psychological factors that determine performance in the various reading tasks sampled in the previous approach.

Problem Description

The outcome of research initiated within this approach should be a series of explicit models of the reading process (for different tasks) which we could use as a foundation for constructing instruments for assessing reading performance (Approach 5.3) as well as for improving reading materials (Approach 5.4). The problems involved in constructing models are somewhat less applied than the problems in either the previous or the following approaches. Still, solutions to the more theoretical problems involved in model construction are essential to achieving more practical objectives.

Division of the Approach

The model building task can be neatly segmented into four separate endeavors, each of which the panel suggests as a major area for research.

(1) We propose that components of reading performance be isolated through task analysis of the reading tasks determined in Approach 5.1. While each reading task may require its own performance model, we hope there will be important common component processes among the models developed for specific reading tasks. It is likely that there are a small number of basic psychological processes which occur for a great variety of reading tasks. Furthermore, several of these have already been investigated in the psychological laboratory, though not necessarily in the context of reading research. In short, the aim of this program is to combine the results of task analyses of socially important reading tasks with process models and experimental methods developed by cognitive psychologists (information-processing models, image analyses, and experimental methods to test such models).

(2) Readers apply both linguistic and extralinguistic knowledge in their attempts to understand printed material. The application of this knowledge occurs at all levels of grammatical and semantic parsing. We suggest research which can explain the contribution of an individual's knowledge base to understanding. The contribution of prior knowledge to reading comprehension occurs at various stages in the reading process and with respect to units of information varying in size from individual words or concepts, to sentences or individual propositions to entire texts or networks of conceptual and propositional information.

We propose that research in this area include (1) studies of the processing of different types of information (graphemic, phonemic, semantic) in word recognition; (2) studies of the structure of the internal lexicon and its development, and of how the reader retrieves lexical information in the process of comprehension; (3) studies of the use of knowledge at the propositional level in comprehension; and (4) studies of the role of inference in building up a knowledge structure during and subsequent to reading a text.

To illustrate how inferences can be important to language understanding, consider the kinds of inferences readers have to draw to make sense of various actions on the part of a speaker. We are not talking here about the inferences of standard logic, but about what has been called "natural logic," i.e., those rules of inference that include specifically nonlogical instances such as conversational postulates. These postulates are involved in interpreting statements such as, "It is cold in here" as a request to turn down the air conditioning (or turn up the heat). These postulates pervade children's stories.

The study of such inference rules is directly relevant to the assessment of reading comprehension. It is probably true that many comprehension failures are not failures to understand the words per se, but failures to put upon these words the intended interpretation, i.e., connecting what is being read with relevant bits of knowledge and drawing certain inferences from it. To what extent this is the case, and how such inference failures are to be assessed (or corrected) is an important research question.

(3) Presently few, if any, agreed-upon methods exist for representing the important linguistic and psychological aspects of text structure. Because knowledge of these aspects is of overriding importance to an investigation of effects of text structure on comprehension, we have recommended that research on the representation of the structure of text and knowledge in general be initiated.

This research would, we hope, lead to the development of standardized textual materials for research. Such a project would

be of immediate usefulness to researchers in this area. Sentences and paragraphs, as well as words, could be scaled along various dimensions (e.g., reading time, abstractness, ease of recall under standard conditions) and analyzed according to some of the theoretical systems that have been proposed. We could then use this scaled material in further research and even more important, we could characterize other newly developed material with respect to these available normed texts.

(4) A common view today is that readers use a large number of the cues available to them, in the context as well as the message itself, to arrive at an interpretation of the reading material specific to their particular reading purposes (task constraints). In fact, readers' conceptions of a task itself are probably an important factor in determining at what level they actually comprehend and remember the text. The fourth program will try to identify some of these psychological components of comprehension processes. The two issues mentioned above appear to be of the most immediate significance: the use of context in comprehension and the effects of task constraints on how much comprehension occurs.

APPROACH 5.3

EVALUATING INDIVIDUAL PERFORMANCE AND INSTRUCTIONAL OUTCOMES

Approach Statement

Develop rational methods for evaluating individual understanding and use of written materials and develop models for testing and for formative and summative decisions about instruction.

Problem Description

The presumption is that current assessment practices have several deficiencies. This panel did not attempt to address all the well-known problems in assessing comprehension. Instead, it chose to concentrate on four problems. Each problem should be the focus of a major research program.

Division of the Approach

(1) The items in currently available reading comprehension tests are not selected or constructed in an orderly, rule-governed fashion. The intuitions and judgments of item writers are paramount. They select reading behaviors for testing without benefit of theory or relevant data. Thus, the behaviors evaluated on one measure of text comprehension may not be the behaviors evaluated on another measure of text comprehension.

The goal of this program is to formulate specific procedures for generating test items or tasks. These procedures will help guarantee that the behaviors we would like to measure are indeed represented on any one test. A key word here is "explicitness." Ideally the boundaries of the class of documents, the rules for generating items or tasks, and the criteria for evaluating performance would be so clearly defined that different evaluators would construct equivalent assessment devices.

Most psychometric research is of little help. Since traditional psychometric theory is directed at the measurement of individual differences, it cannot guide the construction of tests to determine

an absolute level of competence--exactly what the individual knows. Methods of traditional testing are matched to restricted purposes: Traditional test theory informs the test maker which of a previously generated set of items to include in a test in order to insure fine interindividual discriminations, but fails to say how the items should be produced in the first place.

(2) Evaluation is usually not based on an adequate analysis of the general and specific literacy demands of society. As a consequence, test scores may bear little relation to reading performances of specific interest to this panel.

The aim of this program is to develop tests to indicate directly the kind and level of difficulty of materials a person is capable of reading with specified comprehension. The established practice is to represent an individual's reading competence on a grade-equivalent scale. This scale indicates how the individual compares to others, but it permits only indirect answers to such questions as "whether the person would understand a story on the front page of a newspaper" or "instructions on how to complete an insurance claim form." The sorts of tests the panel envisions would consist of categories of words, texts, and other documents scaled for difficulty. The measure of readers' competence would be the probability that they could perform an indicated task within the specified category of verbal material.

With this information in hand, a teacher or supervisor could more easily make informed decisions. A concrete example may illuminate this point. Catalogs constitute a reasonably homogeneous class of documents. They are ubiquitous in occupations that entail repairing complex equipment. The service manager of a garage who knew that a job applicant could successfully answer queries about order number, dimensions, and cost of an automotive part by consulting a mail-order catalog would be in a position to infer that the applicant might make a suitable apprentice in the parts department. Of course, more elaborate measures of vocabulary load and structural complexity could and should be derived to characterize the range of documents with which we can predict success.

(3) Validated conceptions of the processes involved in reading have not entered into the construction of comprehension tests--if only because few conceptions enjoy such a status. Yet tests which are not based on an understanding of the process involved in comprehension can offer little insight into the identification of those processes which contribute to an individual's less-than-perfect reading performance.

The purpose of this program is to refine domain-referenced tests to the extent that they are capable of yielding specific information about individual learning problems. Simply knowing the individual's level of comprehension is not as useful as knowing at what point

comprehension fails. Precise information on where individuals encounter difficulty can fill two important needs in education: (a) It can indicate what the individual should do to fill in his own gaps in comprehension; and (b) it can suggest how instruction should be revised to be more effective in the future.

(4) The purpose of research within this program is to furnish the information necessary for decisions about the content and scope of reading instruction beyond the level at which the basic decoding skills have been mastered. One issue here is whether there ought to be developmental reading exercises aimed at general literacy, apart from the study of specific disciplines and the preparation for specific occupations.

We consider two possible approaches to the idea of general reading instruction (not intended to be mutually exclusive). The first is to develop a program of reading comprehension instruction, teaching people to extract information and ideas from passages written around an inventory of important linguistic structures. A second plausible approach would be to teach people heuristics for self-management of reading activities. Such strategies as self-questioning while reading may be very effective in helping readers to process texts at a sufficiently deep level for full comprehension.

APPROACH 5.4

COMPREHENSION AND THE DESIGN AND EVALUATION OF
WRITTEN MATERIAL FOR EFFECTIVE HUMAN USE

Approach Statement

Develop rational procedures for designing written material for various prespecified human uses, and develop quantitative characterizations of the difficulty and content of these materials.

Problem Description

It is probable that much of the written material used in school and in various tasks of adult life is not optimally comprehensible to the readers for which the materials are intended. The development of a workable definition of "comprehension" under the first two approaches of this panel area will be useful for designing more comprehensible written material as well as for designing appropriate assessment instruments. In fact the maturing of scientific conceptions of comprehension is likely to have substantial impact on how written materials are produced and used. Producers of written material are likely to be helped by insights into those characteristics of users which will affect their comprehension of a document. Specifically, writers need to know how to tailor a document to the experience, abilities, and interests of readers so that they can use it successfully. We can also expect that progress toward describing the successful use of written materials in more explicit and exact terms will foster rational procurement and evaluation procedures for written materials by schools and other consumers.

Division of the Research

The research proposed under this approach will build on the research under the first two approaches to facilitate the production of more comprehensible reading materials. The research under this approach was presented in three fairly distinct programs.

(1) The results of fundamental research on language and learning indicate that task-relevant knowledge and experience is probably the single most important population characteristic that determines the

successful use of a written document. Because writers and readers are often drawn from different milieus, the writer's assumptions about these characteristics are often wrong. In light of this problem, the first program will develop techniques for determining the psychological characteristics of special populations that bear on their successful use of various kinds of written material.

The program seeks to explore useful techniques for characterizing various aspects of population knowledge and to determine how this information for any given target population should be displayed to the writer. The program will characterize populations according to their conceptual and lexical domains. It will analyze the relationship of these domains of knowledge to document content and task demands with the purpose of discovering what information about the conceptual and lexical knowledge of target populations is of value to the writer or editor.

(2) In addition to techniques for characterizing populations, we also need techniques to characterize written materials themselves. This program will develop quantitative indexes for determining the difficulty level and other demand characteristics of written material for certain specified populations. Other indicators will provide measures of the topical content and its organization and of text structure and style. We will also give attention to determining appropriate indicators of the cognitive demand characteristics of nontextual documents (e.g., graphs or charts) with well-specified uses.

(3) Preparing written material is a difficult practical activity. The emergence of new scientific information about the use of written material may make the writer or producer or editor's task at first more difficult rather than easier. This result may build resistance to innovation. It seems barely sufficient to supply writers and editors with basic psychological information on how humans understand, without taking the human limitations of the writers into consideration. We need some imaginative work to help the writer or editor make use of psychological information produced in the previous programs. This program will focus on the development of practical systems and aids for producing written material. It will include a consideration of the usefulness of computers for displaying information about the target population and about the text being produced.

PANEL 6

APPLICATIONS OF EXISTING READING COMPREHENSION RESEARCH

APPROACH 6.1: INSTRUCTIONAL IMPLICATIONS OF CURRENT THEORIES OF LANGUAGE COMPREHENSION

- Program 6.1.1: Development of Schemas or Structures for Comprehension
- Program 6.1.2: Teaching of Strategies for Accessing Comprehension Schemas
- Program 6.1.3: Optimal Organization of Text for Comprehension

APPROACH 6.2: INSTRUCTIONAL PRACTICE AS THE SOURCE OF INSTRUCTIONAL DESIGN AND THEORETICAL MODEL BUILDING

- Program 6.2.1: Identifying Dimensions of Successful Reading Comprehension Instruction
- Program 6.2.2: Investigation of Practices That Now Appear Successful
- Program 6.2.3: The Role of the Computer in Teaching Reading Comprehension

APPROACH 6.3: PSYCHOLOGICAL ANALYSIS OF READING COMPREHENSION TASKS

- Program 6.3.1: Generation of Lists of Comprehension Tasks for Specific Populations
- Program 6.3.2: Analysis of Tasks
- Program 6.3.3: Development of Teaching Techniques
- Program 6.3.4: Development of Tests of Comprehension Based on Task Analyses

PANEL 6

APPLICATIONS OF EXISTING READING COMPREHENSION RESEARCH

Problem Area Statement

This panel focused on the problem of applying the results of theory and research on reading comprehension to educational practice. The panel thought that we could do much to increase the positive interaction between basic and applied research, and between research in general and the needs of practitioners and of the community.

The attempt to build a supportive bridge between applied and basic research is unfortunately often at odds with the attempt to make research responsive to educational problems. It is typically the scientists' stance to withhold policy judgment and to claim that we need more knowledge before we can make any proposals for action. On the other hand, people concerned with meeting immediate and pressing social problems are often impatient of delay, and demand quick and practical programs for widespread use. Each of these approaches poses difficulties. Continual delay of proposals for instructional practice has the effect of sacrificing scientific influence on education. On the other hand, indiscriminate demand for immediate action invites an endless cycle of innovation for its own sake, and a loss of the possibility for building a firm base of principles from which to derive instructional practice. In seeking to develop applications of existing knowledge, this panel tried to avoid the temptations of both of these stances taken as extremes. In so doing, it sought means of mitigating the traditional separation of science and practice, and of thereby bringing about a convergence on an important social problem.

Division of the Research

The proposals that follow are concerned with individuals who have mastered the beginning stages of reading. We assume that the target population has a substantial reading vocabulary and a set of usable strategies for decoding printed words. Moreover we have focused on the comprehension of written materials in the language in which the speaker is already orally fluent. We are not directly concerned with the problems of comprehending second languages, and we give no attention to dialect differences, on the assumption that users of various American dialects are also fluent in understanding standard spoken English. Where this assumption does not hold, the proposals may need modification, or they may be inapplicable.

We propose three approaches to research and development in reading comprehension. They are intended to converge in such a way as to lead to improved instructional practice, well-grounded in theoretical terms, and at the same time, to contribute to a refinement of theory on the basis of instructional experimentation. The first approach begins with a distillation of current theory concerning the way people comprehend language. It attempts to derive from this comprehension suggestions for instructional practice. This is the classical way of looking at the question of "applying" basic knowledge. The second approach begins with an analysis of classroom practice and seeks a formulation of underlying principles that account for success in what appears on the surface to be divergent practice. It recognizes the practicing teacher as a potential source of information, both for an organized theory of the acquisition of reading competence and for aiding other practitioners. The third approach begins with the identification of actual reading tasks and the psychological analysis of those tasks in order to discover the basic processes involved. This approach both suggests instructional practice and constitutes a special form of psychological research in which instructional experimentation elucidates basic theory.

APPROACH 6.1

THE INSTRUCTIONAL IMPLICATIONS OF CURRENT THEORIES OF LANGUAGE COMPREHENSION

Approach Statement

Identify instructional implications of current theories of language comprehension which enjoy a measure of empirical support.

Problem Description

Instructional research can and should draw from the theory and evidence supporting current models of language comprehension. Research on natural language comprehension has mushroomed in the past few years. Whereas a decade ago psychologists would have been hard pressed to offer strong hypotheses about what people did when they understood language, today we have a number of theories and growing amounts of data to call upon. As one might expect, there is at this stage of research no clear consensus among psychologists about comprehension processes. Rather, several theories are now being investigated, any of which ultimately may provide a viable account of aspects of comprehension and several of which can already be mined for instructional implications.

We explore in the panel report one broadly stated theory of comprehension, intending the exploration as an example of how instructional experiments might be derived from current models of language comprehension. The view we chose to focus on holds that comprehension is a process of searching for, and discovering in memory, a schema (model, hypothesis, conceptualization, frame) that accounts for the situation to be understood. Pursuing this view of comprehension brings the topic of reading comprehension directly into the mainstream of current psychological research interests. It unifies the problem of reading comprehension with the more general problem of comprehending the world. The results cognitive psychologists have discovered with regard to these more general considerations are therefore relevant to the present concern.

The discussion in this section follows three steps which we consider essential to any attempt to apply theory to practice: (1) The theory is briefly described; (2) evidence is given for the

scientific soundness of the theory at hand; and (3) the implications of the theory for the teaching of reading comprehension are discussed. The approach is thus meant to parallel--and perhaps serve as a model for--future attempts to derive instructional implications from psychological theory.

The term "schema" has various interpretations. We use it in this report to refer to an abstracted concept of an object or situation. Thus, one's schema for a concept such as "room" would include the idea that it had four walls, a floor and ceiling, was part of a building, etc. How the reader discovers a schema appropriate for a particular passage is perhaps the most difficult question we address and also the most important with respect to implications for reading. This panel considered several possible answers to this question. The panel reported that the techniques developed in the problem-solving literature for "breaking set" or viewing a passage in a new way may be equally important in reading comprehension.

The scientific evidence for this approach to comprehension is abundant. It is, for example, close to the classic Herbartian theory of apperception that influenced educational thought at the end of the last century. It is parallel to the Piagetian concepts of assimilation and accommodation in the sense that comprehension is the assimilation of the thing to be comprehended into the schema, or the match or fit between the thing and the schema, and accommodation is the inevitable and necessary change that takes place in the structure of the schema as a result of the assimilation. There is also a growing body of evidence and opinion within both information-processing psychology and artificial intelligence that supports this approach.

Division of the Approach

Using the schema comprehension model, the panel identified three reasons for failure to comprehend, each of which is the focus of a program of instructional research:

(1) The reader may lack an appropriate schema for interpreting some passage. Research suggested here includes analysis of the knowledge structure of various disciplines and alternate approaches to communicating this structure.

(2) Readers may not be able to access an appropriate schema even though such a schema may be available in their long term memory. The task in this program is to discover teachable strategies that readers who have failed to comprehend can employ to remedy the situation.

(3) The material may be incomprehensible. There may be no single schema that will account for the material. This problem naturally suggests a program of research on optimal organization of text for comprehension.

APPROACH 6.2

INSTRUCTIONAL PRACTICE AS THE SOURCE OF INSTRUCTIONAL DESIGN AND THEORETICAL MODEL BUILDING

Approach Statement

Identify and use insights from current instructional practice for instructional design and theoretical model building.

Problem Description

There are many instructional practices within the schools which can be considered to be successful. Even though not grounded in theoretical statements and empirical research, these successful instructional practices merit investigation. Many educators are working in ways that seem to be effective without necessarily being able to state why their methods work or to articulate a corresponding theory. Clearly, we could gain valuable information if the ingredients for their success could be isolated and defined. Through examination, extrapolation, and augmentation of current practices for teaching comprehension, this approach seeks to formulate a set of principles by which we can derive a variety of specific teaching techniques and organize existing ones.

It is clear that one of the major problems of the proposed approach relates to identifying what is successful. Many practices, however, appear to have a face validity in that learning takes place and educators acclaim the techniques. This approach is based in reality insofar as it speaks to the immediate needs of teachers, and validates their most promising work. It offers the potential for a working partnership between scholars and practitioners and has practical implications with regard to the dissemination of the outcomes. By addressing the relationship between current practices and comprehension processes, we may discover underlying principles which facilitate the development of other successful practices. Perhaps the greatest value of the approach is that it puts into the hands of educators the principles with which to generate further successful practices.

Relevant Research

No general theoretical framework for the approach appears to exist, although it seems to be related to Heider's "naive psychology." There are increasing numbers of intervention programs in schools, mainly in the elementary grades, which seek to promote and disseminate effective practice related to the growth of understanding, but such programs have not been characterized by vigorous attempts to generate and specify the theory underlying them. In consequence, we are now at the point where the lack of sound theoretical bases is beginning to inhibit further progress. We should stress that sound methods for producing such frameworks may be difficult to achieve. Nevertheless, the urgent need to discover what makes effective practices successful and to embody such discoveries in forms which will enable both evaluation of present practice and generation of new tasks to take place, constitutes the rationale for this approach.

Division of the Approach

We propose three kinds of research programs. The first attempts to identify general dimensions of successful teaching practices, and to establish principles which may be used to generate analogous practices. This program seems crucial to the production of a set of guidelines to further effective instruction.

The second program will explore the implications of specific, already identified practices which appear to have had considerable success and which promise further success if well understood and more widely used. These practices include: (a) techniques for improving comprehension by making certain desired actions in the classroom contingent upon comprehending what is read; (b) techniques of training readers to monitor their own comprehension processes; and (c) techniques which selectively widen the knowledge base of the readers.

The third program relates to the use of computers and other technological "hardware." Technological advances have resulted in the availability of small, inexpensive computers. It would seem that these devices could be potent teaching tools if programed to allow students to generate interesting events under their own control and at their own level of aspiration. This program will investigate the computer's potential for teaching reading comprehension.

APPROACH 6.3

PSYCHOLOGICAL ANALYSIS OF READING
COMPREHENSION TASKS

Approach Statement

Identify and analyze reading tasks relevant to school and society.

Problem Description

Ideally, reading instruction should prepare students to carry out without difficulty those reading tasks they can be expected to encounter as adults. It seems logical, then, that reading research should pay some attention to identifying these "real life" tasks and to defining "comprehension" in terms of the successful completion of these tasks.

Despite the difficulties that educators and psychologists have in defining comprehension, there exists within any particular social group a commonsense idea of what it means to comprehend. Typically this commonsense definition is expressed in the form of tasks which, when carried out effectively, are taken as evidence that the individual has comprehended a message. Thus, for example, if individuals can hold a reasonably intelligent conversation about a text they have read, if they can scan the headlines to pick out key news events, if they can follow directions, if they can evaluate a text and support their evaluation, there is little doubt that they have "comprehended" a text at some socially relevant level. Most of these definitions of comprehension are recognized in school practice, although only a few are usually sampled by comprehension "tests."

In this approach we suggest taking the commonsense definition of comprehension as a starting point and, through the process of task analysis, deriving both a theoretical description of comprehension processes and suggestions for relevant instructional practices. The particular value of this approach is threefold. First, starting with actual comprehension tasks assures contact with the demands of real life in school and outside. It avoids the possibility of tying instruction and research to tasks that are convenient on tests or in the laboratory, but not necessarily of practical value. Second,

analysis of these tasks in terms of the psychological constructs currently in use by scientists studying the reading process provides one effective means for bringing psychology to bear on practical tasks. Finally, as a result, we can anticipate a double payoff from this task analysis approach: on the one hand, usable instructional products and techniques; on the other, advances in our theoretical understanding of the nature of comprehension.

Relevant Research

Task analysis is a crucial intervening step that allows psychologists to bring their theories and constructs (developed in the laboratory, often using specially designed experimental tasks) to bear on the complex kinds of behavior that characterize most of our lives. Task analysis techniques of several kinds are being used increasingly among psychologists today. Two task analysis methods seem especially promising for this approach: (a) "idealized process analysis," in which ideally efficient routines for performing a task are laid out and then used to specify instructional routines; and (b) formal information-processing analyses that attempt to describe actual performance (including typical errors) of people on specified tasks. These formal analyses are frequently, but not always, specified in the form of computer simulation programs. They are always subject to a variety of empirical validations that make full use of the range of experimental and descriptive methods now in general use within cognitive psychology.

Division of the Approach

The research proposed is divided into four programs with the following goals:

(1) Generate a list of comprehension tasks that individuals frequently encounter in school and outside. This list may differ according to the age, cultural interests, or educational status of the target population.

(2) Analyze these tasks in psychological terms to produce: (a) a theoretical description of "comprehension" in a particular task environment; and (b) an account of the subskills (strategies and processes) common to a number of different tasks.

(3) Use the analyses to develop teaching techniques of two kinds: (a) direct instruction in the tasks themselves; and (b) instruction in subskills common to several tasks.

(4) Build diagnostic tests of comprehension skills based on the components identified in the task analyses.

PANEL 7

READING COMPREHENSION AND THE HIGH SCHOOL GRADUATE

APPROACH 7.1: STUDIES OF STUDENTS

Program 7.1.1: Characteristics of "New" Students
Program 7.1.2: Experiences of "New" Students Prior to Entering College
Program 7.1.3: Strengths in Background and Characteristics of "New" Students
Program 7.1.4: Case Studies of Academically Successful Students Deficient in Basic Skills
Program 7.1.5: Impact of Pragmatic Academic Counseling
Program 7.1.6: Analysis of Students' Tasks
Program 7.1.7: Conflicts Between "New" Students Concepts of Personal and Academic Life
Program 7.1.8: Variables Affecting "New" Students Desire to Read and Write
Program 7.1.9: "New" Students Attitudes Toward Written Language
Program 7.1.10: "New" Students' Self-Concepts and Attitudes Toward Reading and Writing
Program 7.1.11: "New" Students' Achievement and Learning Styles

APPROACH 7.2: TESTING AND DIAGNOSIS

Program 7.2.1: Survey of Reading and Writing Tests in Use in Colleges and Universities
Program 7.2.2: Development of Diagnostic Tests for Freshmen
Program 7.2.3: Assess "New" Students' Attitudes Toward Reading, Writing, and Specific Content Courses
Program 7.2.4: Effectiveness of Standardized Reading Tests
Program 7.2.5: Identify Deficiencies Prior to Entry to College
Program 7.2.6: Analysis of Textbook Language in Specific Content Areas
Program 7.2.7: Develop Readability and "Teachability" Criteria for College Texts

APPROACH 7.3: INTERVENTION PROGRAMS

Program 7.3.1: Case Studies of Reading and Writing Programs
Program 7.3.2: Evaluation of "Introductory Knowledge" in Content Areas
Program 7.3.3: Guides for Teachers in Evaluating Intervention Programs
Program 7.3.4: Effectiveness of Various Team Approaches to Teaching Reading and Writing in College

APPROACH 7.4: EXPLORATION OF NEW INSTRUCTIONAL STRATEGIES

Program 7.4.1: Compare Separate Skills Training and Integrated Skills-Content Approaches to College Reading Instruction
Program 7.4.2: Role of Television in College Reading Instruction
Program 7.4.3: Introduce Writing into Traditionally Nonwriting Courses
Program 7.4.4: Interrelationships among Writing, Reading, and Spoken Language
Program 7.4.5: In-service Training for College Teachers
Program 7.4.6: Improve Linguistic Sensitivities of Teachers
Program 7.4.7: Case Studies of Colleges with Programs for "New" Students

PANEL 7

READING COMPREHENSION AND THE HIGH SCHOOL GRADUATE

Problem Area Statement

The objective of research in this problem area is to determine how to advance the reading and writing skills of college students whose high school educations have not prepared them for the reading and writing tasks required in higher education.

The stated goal of public education in the United States is to equip all citizens with the necessary skills and information to live productive and fulfilling lives, as defined by the society and by each individual in the society. The awareness of how far short of this goal we have fallen has been dramatically heightened during the past decade by the entry into higher education of many thousands of young adults from diverse cultural, racial, and ethnic backgrounds. The educational needs of these students differ in many respects from those of students who have traditionally participated in higher education. Many of these new students have not developed the basic reading, writing, and study skills required for successful participation in traditional higher education programs. College faculty do not have adequate information about the previous educational experiences and current skills of these students, nor do they know how to alter traditional programs to meet their needs.

Relevant Research

With the creation of large numbers of community colleges, the adoption of open admission policies among a growing percentage of public colleges, and the efforts of private colleges to achieve greater diversity among their students, the problems of underprepared college students have finally been recognized as a major concern of higher education. Estimates of the number of inadequately prepared college freshmen range from one-third of all entering students to 80 percent of the first-year students in selected 2-year colleges.

Some educators doubt that new students have the ability to acquire a high level of proficiency in the basic skills of reading and writing, or to grasp the content of typical college courses. Underlying this doubt is the conviction that, by the time one enters college, it is too late to "catch up" in reading and writing. While there should be further research on this issue, there is some evidence that individuals

can make significant gains in basic reading, writing, and study skills after age 17. This evidence arises from such programs as the Defense Department's Project 100,000; Upward Bound; Job Corps; and others.

Division of the Research

The panel recommended four approaches to determine how to improve the reading and writing skills of the new population of college students. The first approach studies the needs and abilities of new students. The second determines more effective methods for assessing both students' levels of proficiency in reading and writing and levels of proficiency required for successful participation in various higher education curriculums. The third focuses on evaluation of current instructional programs for new students. The fourth calls for the design and evaluation of innovative instructional programs.

APPROACH 7.1

STUDIES OF STUDENTS

Approach Statement

Conduct studies of the needs and abilities of the new population of college students and of the demands colleges impose on these students.

Problem Description

Knowledge about the new populations of college students is fragmentary. As a result, many programs affecting these students have been shaped by inadequately explored assumptions, for example: (1) the assumption that students with serious deficiencies in reading and writing are not capable of mastering these skills after they have entered college; (2) the assumption that the motivations and aspirations of new students concerning a college education are different from those of traditional students, and that these differences are not compatible with academic learning; and (3) the assumption that, despite their skill deficiencies, new students bring to the classroom a world of experience and highly developed cognitive, nonschool skills, which, if properly developed, can enable them to achieve academic success. Before we expend large sums of money on intervention programs for the new population of college students, there should be case studies and surveys to explore their abilities and the demands higher education imposes on them. There should be case studies, for example, of the difficulties new students experience in coping with the demands of studenthood. Unlike traditional college students, many new students lack models for studenthood. Often they are the first of their family or friends to attend college. Having observed teachers only after the teachers have mastered their materials, they often have no sense of what studying entails. In particular, they lack criteria for knowing when they have gone deeply enough into a subject or assignment. They have difficulty assessing the amount of energy or time necessary to carry out an assignment or do not know how to make use of the resources on campus. Often their queries over the number of pages to write, the number of examples to include,

the importance of certain items on tests, appear to be cynical negotiations to avoid work when, in reality, they are trying to have teachers specify the work they expect of them.

Relevant Research

While some research has been undertaken on new students and on the instructional programs serving them, this research has generally been limited to estimates of reading difficulties and studies of attrition rates. Estimates of reading difficulties vary widely because different studies use different criteria. Research on attrition rates has been limited to tabulations of the number of students dropping out rather than to investigations of the factors influencing student attrition--e.g., job demands, family responsibilities, and so forth.

Division of the Approach

Programs under this approach will attempt to characterize new students in terms of their strengths and weaknesses. More specifically, it will give attention to the characteristics, experiences, and motivations new students bring to the academic setting, the demands of studenthood, and attitudinal variables affecting reading and writing ability.

APPROACH 7.2

DIAGNOSIS AND TESTING

Approach Statement

Develop more effective ways of measuring the reading and writing skills of the new population of college freshmen and the reading and writing demands imposed by various higher education content areas.

Problem Description

Educators lack accurate ways of measuring the reading and reading-related skills of the new population of college freshmen. As a first step in determining specifications for more adequate tests, we need to survey the testing programs currently in operation at higher education institutions. We need to know, for example, what tests are used to assess reading and writing skills, how these tests are selected, how teachers use the results in making instructional decisions, and what criticisms users have of existing tests.

The instruments currently available for diagnosing the reading and reading-related skills of the new population of college freshmen are open to criticism on several grounds. Many were written and normed for children; thus, they fail to measure the conceptual and specialized vocabulary growth that occurs during adulthood. Second, current tests measure not only the students' levels of basic skills, but also their awareness of test-taking strategies. Many adults have not learned the strategies for taking conventional standardized tests; thus, the tests do not accurately measure their reading skills. Third, current tests fail to provide a detailed diagnosis of the kinds of difficulties students encounter in reading. That is, the tests tabulate a student's errors without yielding information about the factors producing these errors. Fourth, the tests are norm- rather than criterion-referenced. In other words, they compare students with one another rather than describing the skills each student has mastered.

Educators also lack accurate ways of measuring the reading and writing demands imposed by various higher education content areas. Different content areas may confront the student with quite different reading demands. Some students, for example, may be able to read an

introductory political science textbook successfully and yet be unable to handle the demands of an introductory biology course. There should be better measures of the special reading skills required to comprehend textual material in various content areas. These measures should assess the level of complexity and abstractness of the concepts used in various disciplines, the text processing strategies required, and so on.

Division of the Approach

Programs under this approach will survey testing practices of higher education institutions to determine how reading and reading-related skills are assessed and what additional techniques and instruments are necessary. It will also develop new diagnostic tests and examine the kinds of reading comprehension demands imposed by various academic disciplines.

APPROACH 7.3

INTERVENTION PROGRAMS

Approach Statement

Conduct studies of the effectiveness of current programs in improving the reading and writing skills of the new population of college freshmen.

Problem Description

A variety of intervention programs have been undertaken to improve the reading skills of postsecondary students. These include programs initiated by individual teachers, programs initiated by institutions of higher education, programs initiated outside the traditional academic setting, programs developed under the GI Bill of Rights, and programs specifically designed for open admissions students. We lack accurate information about the instructional contexts, methods, materials, and results of these programs. Under the heading "instructional contexts," one issue requiring exploration is whether reading instruction should be provided in conjunction with or independently from instruction in various academic content areas. A second problem requiring exploration is the effect of various higher education environments (e.g., a university-without-walls program as against campus-based instruction) on the learning of basic skills.

Relevant Research

There have been few evaluations of programs to improve reading and writing skills of college freshmen. The studies that do exist may be criticized on several grounds. The research methods have been crude, involving mainly t test comparisons of pre- and post-test differences in grade point averages. Studies have not been replicated to produce generalizable results. Where a particular teaching method has been tested, the method often was not designed for use with college-age students.

Division of the Approach

The programs suggested here involve surveys and case studies of interventions to improve the reading and writing skills of college freshmen. The approach will give special attention to the effectiveness of arrangements for combining the skills of content area teachers with those of other educational personnel such as reading teachers, counselors, and psychologists, and will develop guides and models for use by teachers in evaluating intervention programs.

APPROACH 7.4

EXPLORATION OF NEW INSTRUCTIONAL STRATEGIES

Approach Statement

Determine more effective methods and techniques for improving the reading and reading-related skills of postsecondary students.

Problem Description

We must envision and evaluate new approaches to improve the reading and reading-related skills of postsecondary students. One approach is to combine the two major models of reading instruction used at the postsecondary level: skill-based instruction (instruction by reading specialists in reading skills general to a variety of academic content areas) and content-based instruction (instruction by content area teachers in reading skills related to individual content areas). Both models have certain disadvantages. The disadvantage of skill-based instruction is that it is usually labeled "remedial reading," a label implying that participating students are not ready for college-level work. The disadvantage of content-based instruction is that content area teachers are often neither trained nor interested in providing instruction in reading. Each model may be better suited for teaching some reading skills than others. Combinations of the two models need to be devised to take advantage of each one's unique strengths and weaknesses.

A second approach to improving the reading-related skills of postsecondary students is to build on a student's linguistic communication strengths. For example, a student who is especially competent at orally communicating a set of concepts might be provided with printed materials on those concepts as a way of developing reading skills. Third, television should be investigated as a medium for improving the reading skills of postsecondary students. Students who can understand ideas presented visually and orally on television might be encouraged to explore these ideas through the medium of print. In this way, they can get a sense of what print is attempting to communicate. A fourth approach to improving the reading skills of postsecondary students is through in-service training to broaden the linguistic sensitivity of college faculty. College faculty are

accustomed to the specific writing styles used in their disciplines and may have negative attitudes toward the language styles of students from nonmajority cultural backgrounds. One way of overcoming these attitudes may be through exposing faculty to the broader phenomena of language: the nature of language as an oral symbolic system, the nature of dialects, how the English language has evolved, and current research on reading, writing, and comprehension skills. A final strategy for improving the reading skills of postsecondary students is to identify factors producing resistance to change among postsecondary educational institutions. Widespread changes are required of these institutions to meet the needs of the new population of college freshmen--changes in course content, sequencing, and structuring, training programs for instructors, the introduction of counseling and other support services, and so forth.

Division of the Approach

The programs under this approach will investigate ways of combining current models for providing reading instruction to postsecondary students, explore the use of writing and television, develop in-service training programs for teachers, and investigate institutional resistance to change and how it can be surmounted.

PANEL 8

LEARNING AND MOTIVATION IN EARLY READING

APPROACH 8.1: INDIVIDUAL DIFFERENCES IN ACHIEVEMENT MOTIVATION

- Program 8.1.1: Incentive Differences in Achievement Motivation in Different Child Populations
- Program 8.1.2: The Role of Sociocultural Factors in the Development of the Achievement Motive
- Program 8.1.3: Sociocultural Influences on Motivation to Learn to Read

APPROACH 8.2: EFFECTS OF DIFFERENCES IN INSTRUCTOR-LEARNER RELATIONSHIPS ON LEARNING TO READ

- Program 8.2.1: Teacher-Learner Interaction Systems
- Program 8.2.2: Use of Nontraditional Instructors

APPROACH 8.3: INSTRUCTIONAL APPROACHES

- Program 8.3.1: Teaching-Learning Situation in the Acquisition of Reading
- Program 8.3.2: Developing Adequate Measures of Reading Skill Acquisition
- Program 8.3.3: Effects of Variations in Beginning Reading Curriculums
- Program 8.3.4: Effects of Preschool Programs on Early Reading
- Program 8.3.5: Role of Time in the Acquisition of Basic Reading Skills

APPROACH 8.4: RELATIONSHIP OF READING SKILLS TO OTHER LANGUAGE COMMUNICATION SKILLS

- Program 8.4.1: Children's Knowledge of Syntax
- Program 8.4.2: Listening Skills and Reading
- Program 8.4.3: Early Writing Skills
- Program 8.4.4: Use of Media

PANEL 8

LEARNING AND MOTIVATION IN EARLY READING

Problem Area Statement

Identify, develop, and compare means by which we can strengthen and maintain children's motivation to learn basic reading skills.

Problem Description

In our efforts to improve reading comprehension in the later grades, we cannot ignore instruction in early reading skills. It is evident that the focus on comprehension, reading to gain meaning from a written message, need not be relegated to the later years. It can be an effective part of the early reading curriculum, giving a richer context to the traditional skills required of beginning readers. This early meaningful interaction with written material can guide the conceptual growth that will be the base for later, more advanced, comprehension abilities. It can also motivate children by giving them a feel for the range of meaningful materials that will be accessible to them once they learn to read. In a broader sense, the experience of learning to read, of interacting with teachers and other children in the classroom, sets the stage for the whole complex course of motivational and cognitive changes throughout schooling.

In a similar vein, children's even earlier experiences, at home and in preschool learning contexts, help set the stage for the course of their classroom learning and help provide them with interpersonal skills and knowledge to bring to the task of learning to read. "Readiness" is much more than just the possession of some discriminative responses to pictures and letters. It must be regarded as a whole range of factors which includes the fit between children's prior experiences in society, their subculture, and their families, and the structure of the instructional context in which they find themselves.

Relevant Research

Investigations of children learning to read and the design of strategies for reading instruction have been among the most active areas of educational research and development. From these efforts have flowed a substantial body of research literature about early reading, as well as a plethora of programs and instructional strategies aimed at the effective teaching of reading to young children.

In the panel's view, however, there are significant dimensions of the problem which have been generally overlooked or have been inadequately investigated and which encompass much more than learning to read. The panel maintains that these dimensions are essential to study if a fuller understanding is to be gained of significant factors that can interfere with a child's acquisition of basic reading skills.

Division of the Research

The panel identified four areas as meriting further investigation. The first approach focuses on the sociocultural influences which help to determine individual differences in the attitudes, motivations, and skills of young learners. The second approach explores the dynamics of teacher-learner interactions. The third develops procedures for investigating the instructional setting and its effects upon the learner. The last considers learning to read in the context of broader communication skills children are developing as they learn to read.

APPROACH 8.1

INDIVIDUAL DIFFERENCES IN ACHIEVEMENT MOTIVATION

Approach Statement

Determine the sociocultural influences that contribute to individual differences in attitudes toward school and in motivation to achieve in school.

Problem Description

American children generally live within the boundaries of two sociocultural systems, the home and the school. For children of the educated middle classes, these sociocultural systems are essentially compatible. For the most part, communication and human relational styles, as well as cognitive and motivational styles, are similar in each setting. There is therefore little difficulty in devising strategies of reinforcement and motivation for these children.

For many other children, however, the sociocultural systems of home and school are incompatible. Teachers often experience frustration when they find that the reinforcement and motivational strategies which work with middle-class children do not work with these children. Such children are commonly described as lacking motivation to achieve; but what we need to recognize is that the classroom environment itself may not reflect the reinforcement and motivational characteristics with which these children are familiar in their home settings.

We need to identify the reinforcement and motivational characteristics that are specific to the different sociocultural systems that exist in the United States. Once these characteristics have been determined, a number of basic issues arise. For example, a major policy issue is the following: If the socialization experiences of the home are different from those emphasized in the school, should the school (a) ignore the home experiences and concentrate on developing the child's receptivity and responsiveness to the reinforcement and motivation strategies that are emphasized in the school; (b) incorporate the strategies that are characteristic of the child's home socialization patterns; or (c) construct its

environment so that it conveys the existence of differing motivational and reinforcement characteristics and provides exposure to all forms for all children?

Clearly these are important policy decisions facing public education today, particularly as political pressure increases for schools to adopt practices supportive of cultural pluralism. The shape, form, and nature of these policies, especially as they apply to the area of motivation, require research that delineates the issues of educational practice that are involved.

Relevant Research

At the present time, the development of educational practices related to motivation are complicated by the fact that current achievement motivation theory assumes a model of motivation stressing benefits to individuals in the form of grades, promotion, praise from the teacher, and so on. It stresses competitive behavior oriented toward personal gain as one of the major instrumental routes to achievement. However, recent research implies that the incentives underlying achievement motivation may differ, depending on the nature of the socialization experiences of the individual. For example, it now appears evident that for a number of sociocultural systems (those representative of certain groups of Black Americans, Mexican Americans, Puerto Rican Americans, Japanese Americans, Chinese Americans, and others) the goal of socialization is to develop in the child a strong sense of loyalty and responsibility to the family. The individual's personal identity within this type of socialization framework is intricately linked with the family. It appears to be developed early in life and subsequently generalized as an achievement motive that stresses benefit to others. To strive for individual gain is considered to be selfish. Indeed, competitive behavior which stresses personal advantage is seen as being destructive to the family.

Division of the Approach

The approach has been divided into three programs. The first explores incentive differences in achievement motivation in different child populations. It assesses children's relative preference among several incentives, e.g., achievement for self-betterment as opposed to achievement for the benefit of others. The second attempts to relate these incentive differences to different styles of socializing children in the different cultural groups in the United States. The final program relates children's motivations specifically to reading. It asks why a child would want to learn to read in the first place.

APPROACH 8.2

EFFECTS OF DIFFERENCES IN INSTRUCTIONAL SYSTEMS AND IN INSTRUCTOR-LEARNER RELATIONSHIPS ON LEARNING TO READ

Approach Statement

Describe how interactions in classrooms between pupils and instructors or instructional devices affect the process of teaching and learning how to read.

Problem Description

The study of teacher-pupil interactions may contribute in four general areas. First, there is potential for the design of radically new and more productive methods of reading instruction once we better understand the nature of instructor-learner situations. Second, there is potential for the preservation and enhancement of diverse cognitive and social styles, within as well as among individuals, as a positive benefit to the reading process rather than as a hindrance in its acquisition. Third, there is potential for training the reading instructor, tutor, or classroom teacher better to recognize the responses that signal different types of difficulty and different types of motivation in children from a wide variety of backgrounds. Fourth, there is potential for designing preschool experiences, and even for facilitating earlier parent-child interaction around learning tasks, so as to give all children the benefits of a rich history of participation in teaching-learning situations before they start school.

Relevant Research

In supporting investigations of the experiences, values, skills, and styles which young children and their teachers bring to their interaction, it is useful to focus upon theories which regard the teacher-learner interaction as an open and adapting social system. The idea of an open system entails a purposive approach to behavior. Open systems are goal-seeking systems which use feedback to reduce discrepancies between actual and intended states. In so doing, the open system not only reaches its goal more efficiently than could be achieved by trial-and-error but also accommodates itself so as to be

better adapted in subsequent pursuits. It is commonly accepted that human organisms are among the most open of open systems, least restricted by innate endowment and most dependent upon learning in their development.

Recently, research has indicated that a social group of two or more members also can be regarded as an open system, following much the same course of development as a single organism. A mother and infant together, for example, change their behavioral sequence of signaling and feedback over a period of time so as to achieve mutual goals different from the individual goals with which each partner began. The new patterns of behavior which result for the dyad will persist until they are further adapted in the course of development. The major implication of recent work on parent-child interaction is that, from infancy onward, children shape the course of their own learning.

We will view the teacher-learner interaction as such an open system, although our ultimate major concern is the information flowing from teacher to learner. The open system approach argues that this flow is only possible because of the two-way exchange of information, a communication which is the learning process itself.

The crucial part of this picture is the background experience of the two partners. A teacher and learner are not naive with respect to one another's signals, responses, and expectancies. Their initial interaction is a matter of transfer from earlier experiences with other adults and children, particularly from other teacher-learner dyads of which they have been members. The rationale presented here clearly suggests a need for better understanding of the development of prior communication skills in both partners, and of the process of transfer of those skills to the classroom. How does that transfer come about? How can it be facilitated, for both child and teacher?

Division of the Approach

The approach is divided into three programs according to the kind of instructor involved in the interaction. The first program formulates information-processing models of teacher-learner dyads as open systems, with particular emphasis upon longitudinal effects of the child's and the reading teacher's experiences in various teaching-learning situations prior to their interaction in the reading class. The second program looks at television instruction and investigates ways to make effective use of this potentially powerful medium of instruction. Although this situation is one in which communication goes one way only, we do go so far as to imagine the development of an interactive television system for the future. The final program will determine the advantages and disadvantages of

having nontraditional instructors such as peers or older children teach reading. It is likely that the interactions typical of child-child learning dyads differ from those typical of adult-child dyads. Such differences may facilitate particular kinds of learning.

APPROACH 8.3

INSTRUCTIONAL APPROACHES

Approach Statement

Study the effects of differences in instructional approaches and sequences of instructional experiences on learning to read.

Problem Description

This ambitious approach consists of programs which address two of the major problems currently at issue in evaluation methodology: analysis of classroom processes and measurement of outcomes. We need to develop methods for evaluating programs that program planners, school administrators, and teachers can easily use. With the increasing interest in school accountability, accurate measures of program effects and implementation become important, as do effective techniques for diagnosing and correcting problems--problems both at the individual student level and at the level of programs and curriculums.

Division of the Approach

The approach has been divided into five programs each of which will be discussed in some detail below:

(1) Although classroom observation instruments have increased in sophistication in the past few years, we still lack instruments which can accurately describe teaching and learning processes specific to reading. The accurate description of processes so complex, so important to the entire schooling process, and so critical to an individual child's self-concept and future opportunity as the teaching and learning of reading merits study in its own right. However, such a description is also a means to another important end, i.e., it has the potential for yielding a set of factors which can subsequently be studied experimentally. Experimental studies of reading acquisition have suffered from the fact that we have not always manipulated or controlled critical variables in the teaching-learning process. An

adequate description of the process as it exists, the goal of this program, will give us a clearer picture of what variables are likely to have the greatest payoff in experimental studies.

(2) The state of the art in assessing reading skills leaves much to be desired. Both the assessment instruments themselves and the uses to which they are put have been inadequate. In the area of instruments two untenable alternatives exist. On the one hand there are a host of standardized survey tests which were designed to be appropriate to the entire spectrum of reading curriculums and thus fail to adequately assess skills taught by any single curriculum. On the other hand, there are a very large number of tests of discrete reading skills which are appropriate to single curriculums but which cannot be used to evaluate multiple approaches. What we need here are instruments to assess reading skill acquisition at a level of specificity sufficiently general to allow for program and individual evaluation and change among curriculums, and yet sufficiently precise to allow teachers to interpret the data and implement changes within their own classrooms.

Procedures for making use of assessment instruments also have often been inadequate. Some typical problems have been (a) stating objectives in nontestable form, (b) using instruments not keyed to objectives, (c) testing only some of the expected outcomes, (d) testing only at the end so that no evidence is available for evaluating program components. This program seeks to correct some of these present inadequacies in instruments and program evaluation procedures.

(3) Using the procedures and instruments developed in the previous program, this program experimentally evaluates variations of a beginning reading curriculum in order to determine which variations optimize instructional outcomes. The research here will demand a fairly complex research design. We feel that it is feasible to plan research designs that both handle the complexities that arise in curriculum planning and development, and achieve the rigor of control deemed necessary in behavioral experiments.

(4) The question of how best to use the preschool years in a child's life is an important one. Most children in this country attend a year of kindergarten; many attend a preschool or nursery school before that. Instructional programs at this level vary widely, but generally there is no effort to teach reading as such, and language arts programs are haphazard. We think that preprimary school experiences might be used to considerable advantage to increase the chance that every child will become a fluent reader. Using the procedures developed in the first two programs of this approach, this program will study the effects of variation in kindergarten and preschool programs on acquisition of reading and language arts in the early grades.

(5) Of all the classroom variables which might possibly affect children's achievement, the time they spend on learning a task may be one of the more important and manipulable ones. Intuitively, at least, children's proficiency in a given area should somehow be related to the amount of time they actually spend learning and practicing skills in this area. With the development of more sophisticated classroom observation techniques, it now becomes possible to explore time as a classroom variable and to develop interventions to encourage a more effective use of the children's classroom time. This program will study the role time plays in the acquisition of basic reading skills. It will focus not only on measuring total time the teacher spends on instruction, but also on refining these totals to reflect the amount of time that the children actually use effectively and appropriately.

APPROACH 8.4

RELATIONSHIP OF READING SKILLS TO OTHER LANGUAGE COMMUNICATION SKILLS

Approach Statement

Study the relationship between learning to read and learning in related areas such as syntax, listening, and writing.

Problem Description

Children's knowledge of language is by no means complete by the time they begin school. While they are learning to read, their language abilities are constantly expanding, as a result of natural maturation, new experiences, and possibly the reading instruction itself. It is important, then, to view reading instruction within this larger context. It should both take advantage of the broader language of the child and effectively work to expand this knowledge.

Division of the Approach

We could have suggested here a number of broad programs exploring the development of linguistic, conceptual, and experiential knowledge in the child. Instead, we chose to focus on three programs which seem to have direct relevance to reading instruction in the classroom.

(1) Evidence is mounting that syntactic development as evidenced in oral language is not complete by age 4 or 5. Children's understanding of complex syntactic structures continues to develop through the school years. If we can characterize the order of syntactic development and if we can assess the syntactic knowledge of individual children, then we may be able to give children texts appropriate to their level of syntactic knowledge.

(2) In the early years, before children have achieved a certain speed and facility with the written word, listening may be the primary means of expanding language knowledge. At this stage, children should not be expected to understand written words and sentences which they cannot understand when spoken. In fact, early listening ability may be the limit which early reading ability will reach once children have

mastered decoding; therefore, listening ability may be a useful predictor of reading ability. This program will explore the ways in which this expanding knowledge of oral language transfers to reading skills. It will also consider when, if ever, reading skills begin to surpass listening skills.

(3) Just as children learn to speak as they learn to understand spoken language, it may be useful for them to learn to write as they learn to read. Current research suggests that it is important for readers to take an active attitude toward what they are reading. Allowing children to write, to compose their own texts, may encourage this active attitude toward written language. Such activities may serve other useful purposes--they might impress upon the children the fact that words on a page represent the spoken language that is already familiar. They may also suggest to the child the purpose of written language--another way of communicating and preserving thoughts. Finally, use of texts written by classmates may be a way to motivate otherwise uninterested children to learn to read. This program will investigate the use of writing in early reading curriculums. In addition it will touch upon the usefulness of a focus on spelling in the early years.

PANEL 9

READING STRATEGIES FOR DIFFERENT CULTURAL AND LINGUISTIC GROUPS

APPROACH 9.1: IDENTIFICATION OF CHARACTERISTICS OF CHILDREN FROM DIFFERENT CULTURAL AND LINGUISTIC GROUPS THAT ARE RELATED TO THEIR LEARNING OF READING AND OTHER COMMUNICATION SKILLS

- Program 9.1.1: Investigation of Social Variables Which Affect Learning of Reading and Communication Skills in Children of Different Cultural and Linguistic Groups
- Program 9.1.2: Investigation of Cultural Variables that Affect Learning of Reading and Communication Skills in Children of Different Cultural and Linguistic Groups
- Program 9.1.3: Investigation of Linguistic Variables that Affect Learning of Reading and Communication Skills in Children of Different Cultural and Linguistic Groups
- Program 9.1.4: Investigation of Variables Related to Hemispheric Dominance that Affect Learning of Reading and Communication Skills in Children of Different Cultural and Linguistic Groups

APPROACH 9.2: IDENTIFICATION OF TEACHING CHARACTERISTICS THAT ARE EFFECTIVE IN TEACHING READING AND COMMUNICATION SKILLS TO CHILDREN OF DIFFERENT CULTURAL AND LINGUISTIC GROUPS

- Program 9.2.1: Investigation of Differences in Teaching Styles Among Teachers to Determine Their Relationship to the Learning of Reading and Communication Skills in Children of Different Cultural and Linguistic Groups
- Program 9.2.2: Investigation of Methods of Teacher Preparation with Respect to Linguistic Variables and Cognitive Styles
- Program 9.2.3: Investigation of Teacher Training Programs that Encourage Teachers to Consider the Sociocultural Systems and Cognitive Styles of Children and Parent Teaching Styles which These Children Have Experienced

Program 9.2.4: Investigation of Teacher Characteristics Related to Effectiveness of Teaching Reading and Communication Skills to Children of Different Cultural and Linguistic Groups

APPROACH 9.3: THE INVESTIGATION OF LEARNING ENVIRONMENTS--IDENTIFICATION OF CHARACTERISTICS CONSONANT WITH THE PSYCHODYNAMICS OF CHILDREN OF DIFFERENT CULTURAL AND LINGUISTIC GROUPS

Program 9.3.1: Investigation of the Effects of Different Classroom Arrangements on the Learning of Reading and Communication Skills

APPROACH 9.4: INVESTIGATION OF THE EFFECTS OF COMMUNITY (PARENTS, PEERS, SIBLINGS, AND MEMBERS-AT-LARGE) ATTITUDES, BELIEFS, AND INVOLVEMENT ON THE LEARNING OF READING AND COMMUNICATION SKILLS IN CHILDREN OF DIFFERENT CULTURAL AND LINGUISTIC GROUPS

Program 9.4.1: Identification of the Effects of Attitudes and Beliefs of the Culturally and Linguistically Different Communities Toward School and School Achievement; Specifically, the Learning of Reading and Communication Skills

Program 9.4.2: Investigation of the Effects, Particularly on the Learning of Reading and Communication Skills, of the Attitudes and Beliefs of the Parents as to What the Nature of Their Involvement in Schools Should Be

Program 9.4.3: Investigation of the Effects of Programs Which Have Made Use of Parents, Peers, Siblings, Tutors, or Any Other Community Resource Other Than Regular Teachers for the Teaching of Reading

APPROACH 9.5: IDENTIFICATION OF CHARACTERISTICS OF INSTRUCTIONAL MATERIALS CONSONANT WITH THE LEARNING, INCENTIVE-MOTIVATIONAL, HUMAN-RELATIONAL, AND COMMUNICATION STYLES OF CHILDREN FROM DIFFERENT CULTURAL AND LINGUISTIC GROUPS

Program 9.5.1: Determination of the Effectiveness of Existing Instructional Materials with Children from Different Backgrounds

Program 9.5.2: Investigation of the Effects of the Cultural Content of Instructional Materials on Children from Different Backgrounds

Program 9.5.3: Investigation of the Effects of Instructional Material Used in the Home

APPROACH 9.6: IDENTIFICATION OF THOSE CHARACTERISTICS OF ASSESSMENT INSTRUMENTS, TECHNIQUES, AND MATERIALS NECESSARY FOR THE EFFECTIVE ASSESSMENT OF READING AND COMMUNICATION SKILLS OF CHILDREN FROM DIFFERENT CULTURAL AND LINGUISTIC GROUPS AND FOR THE ASSESSMENT OF TEACHING STRATEGIES, LEARNING ENVIRONMENTS, AND INSTRUCTIONAL MATERIALS FOR CULTURALLY AND LINGUISTICALLY DIFFERENT CHILDREN

Program 9.6.1: Critical Reviews of Assessment Instruments and Techniques Now in Use Which Affect the Reading and Communication Skills of Children from Culturally and Linguistically Different Backgrounds

Program 9.6.2: Review and Identification of Existing Instruments, and Development of New Instruments Which Assess Learning Styles, Teaching Styles, Learning Environments, Instructional Materials, and Community Participation

Program 9.6.3: Investigation of Testing and Assessment Phenomena

PANEL 9

READING STRATEGIES FOR DIFFERENT CULTURAL AND LINGUISTIC GROUPS

Problem Area Statement

The aim of Panel 9 was to determine how children from different cultural and linguistic groups can be given the best opportunities for developing reading skills.

Although the literature on reading is extensive and varied, the greater part of it is concerned with technical aspects, such as sound-symbol relationships, eye movements, memory span, etc., or with methods for reading programs. Until recently, at least, there has been less concern with the social, cultural, and linguistic background of children. For the most part, researchers seemed to ignore these variables, presumably assuming that the children's background would differ little from their own, or have little effect on learning to read. However, it has become clear that the high rate of failure among children of different cultural and linguistic groups may be in part a result of a continuing failure of educators from the mainstream culture to understand the situation in which such children find themselves upon entering school.

The sociocultural system of such groups differs from those of the mainstream American middle class in language, attitudes, and values. The values of these groups are reflected in the teaching styles of parents, which in turn result in learning, incentive-motivational, human relational, and communication styles characteristic of each group. Schools have not generally been responsive to the unique characteristics of students from different cultural and linguistic groups. Instead they have usually attempted to force these students to conform to the sociocultural systems of the school resulting in value conflicts, anxiety, and frequent failure for these students.

Relevant Research

Recent research has indicated that there is frequently a mismatch between teaching strategies, learning environments, curriculum materials, and assessment instruments and practices on the one hand, and the learning, incentive-motivational, communication, and human relational styles of different cultural and linguistic groups on the other. The research programs advocated here are intended to enable schools to be

more responsive to those individual and cultural differences among children which affect the learning of reading and communication skills.

The methods for carrying out the research are almost as important as the research itself. Too often in the past, different cultural and linguistic groups have been subjected to intrusive investigation by outsiders unresponsive to the cultural values of the group and too unfamiliar with the environment to obtain meaningful results. We accordingly recommend that, as far as possible, research on cultural and linguistic groups be carried out by scholars from the group being studied and always with the approval and involvement of the local community. Where the researchers do not belong to the particular group they propose to study, their research should be funded only if they can demonstrate to representatives of the community that they are responsive to the needs and sensitive to the values of that particular group.

Division of the Research

Because the problem area is so comprehensive that it involves almost every aspect of reading research, there was some difficulty in limiting the scope of investigation. We identified six areas of primary concern: (1) the characteristics of the child, (2) teaching, (3) learning environments, (4) the role of the community and the home, (5) instructional materials, and (6) assessment.

APPROACH 9.1

THE CHARACTERISTICS OF THE CHILD

Approach Statement

Identify characteristics of children from different cultural and linguistic groups that are related to their learning of reading and other communication skills.

Problem Description

The organization of curriculum, training of teachers, preparation of instructional materials and development of assessment techniques requires accurate information about the children for whom they are designed. Traditionally, schools have been oriented toward children with whom school personnel were most familiar, those from the mainstream culture. The research described in the following four programs is designed to remedy this situation by providing the necessary information about children from linguistic and cultural groups which differ from the mainstream culture.

Division of the Approach

(1) The first program investigates social variables and their relationship to the development of reading and communication skills in children of different cultural and linguistic groups. Social variables to be considered include socioeconomic class, education of parents, family roles and relationships, characteristics of the community, and migration. Information about the relationships between the development of cognitive styles in children and these variables is almost nonexistent.

(2) While most of the research on different cultural and linguistic groups has been in the area of values, it is deceptive because most of this research is inaccurate and outdated. When one considers that this research is all that is available for use in teacher training programs to sensitize teachers to the values of other cultures, one comes to appreciate the gravity of the problem. This program investigates cultural variables that affect the way children from different cultural and linguistic groups learn reading and communication skills.

This program calls for research by investigators familiar with the sociocultural system of the group they are studying and for using approaches and techniques which abandon both paper and pencil and impressionistic methods of data collection.

(3) An understanding of linguistic variables is crucial to teaching reading. This program is aimed at providing the teacher and curriculum writer with accurate information about children's language and the linguistic variables which may affect their task of learning to read. Information teachers and curriculum writers currently use is often inappropriate. For example, reading and language arts materials are sometimes graded in terms of difficulty on the basis of the proportion of "hard words" in the text. But the definition of "hard words" is usually taken from frequency counts based on adult language usage and, thus, may be inappropriate for any young child, particularly so for a child from a different cultural or linguistic group. In her study of middle class Anglo-American children, Chomsky (1969) discovered that many of these children, up to the age of 8 or 9 had problems with such apparently "easy words" as ask and tell. It was only after careful testing that the problem became apparent. If such a situation can pass undetected for so long in the majority language and culture, it is highly unlikely that teachers and curriculum writers will have a more accurate conception of the language of children from different cultural and linguistic groups.

This program attempts to answer such questions as: What is the relationship between the children's own language and the variety of language in which they are being taught to read? Specifically, what is the relationship between the children's pronunciation and the orthographic representation of the standard language? What are the differences between the children's syntax and vocabulary and the forms in the reading materials? What is the effect of these various differences? What are the advantages and disadvantages, for bilingual children, of being taught to read in either of their languages first? Basic to all such questions is an accurate description of the children's language itself. Consequently, this program also includes provision for such research.

Recently, the work of Labov and his associates has led to the development of satisfactory techniques for studying language. While it would be unwise to claim that these techniques have now been perfected, there is at present a recognized approach to the study of language in its social context which permits implementation of adequate research designs.

(4) The last program investigates variables related to hemispheric dominance which affect learning of reading and communication skills for children from different cultural and linguistic groups. It will determine those cultural variables related to left brain as opposed

to right brain dominance, and the relationship of hemispheric dominance to cognitive style and to different instructional approaches. Although educators have been talking about brain dominance for a number of years, they have for the most part been unable to translate their discussion into meaningful educational terms. The key here may be cognitive styles. If one conceives of teaching styles and curriculum materials as reflecting a cognitive style, and if there is a relationship between hemispheric dominance and cognitive style, then the results of this program could be very meaningful in terms of educational change.

APPROACH 9.2

TEACHING

Approach Statement

Identify teaching characteristics that are effective in teaching reading and communication skills to children from different cultural and linguistic groups.

Problem Description

Children from different cultural and linguistic groups may experience failure in the schools because their human-relational, incentive-motivational, communication, and learning styles are unfamiliar to teachers. Such failure may be due to teachers' inability to capitalize on the assets of these children, to communicate effectively with them, or to establish interpersonal relationships with their parents which could result in greater continuity between the experience of the home and that of the school. The following four programs are designed to increase teachers awareness and knowledge of the needs of children from different cultural and linguistic groups.

Division of the Approach

(1) The style of teaching a teacher brings to the classroom can be an important factor in children's success or failure in learning to read. Successful matching of cognitive styles of teachers (as reflected in teaching strategies) with the varying cognitive styles of students could be a significant way for schools to respond to the needs of the children. This program investigates effects of matching teacher and student cognitive styles on student academic achievement.

(2) Because most teachers are from the dominant culture, it is vital that they be accurately informed about the children they are teaching. Specifically, teachers should understand the varying linguistic backgrounds and cognitive learning styles of the children they will teach. This program investigates methods of preparing

teachers to teach children from different cultural and linguistic backgrounds. The results of this research should be useful not only in designing curriculums for teacher education programs but also for inservice training.

Past research may not encourage optimism in this area. For example, the history of previous attempts to apply results of theoretical linguistic research to the teaching of English and foreign languages in the U.S. shows that they have been disastrously ineffective. As a result, many teachers are skeptical about the usefulness of linguistics. Similarly, information on cognitive styles available to teachers who were individualizing instruction proved to be ineffective. However, recent research in linguistics and sociolinguistics and in the area of cognitive styles has produced information which should be of much greater relevance to teachers.

(3) This third program investigates methods for training teachers to understand the sociocultural premises, linguistic background, and learning styles of different cultural and linguistic groups. The findings of this research can be used to develop curriculums for teacher training programs in cultural pluralism or bicultural and multicultural education, and, also, in inservice training. There is little hard research in this area. The useful data that do exist have evolved mostly from Follow Through, Head Start, and Title VII programs. While this program is a high risk program, it is an important one. It does involve attitude change, inasmuch as some teachers presently hold negative stereotypes, and efforts in this area have been generally unsuccessful.

(4) The last program will seek to identify the characteristics of teachers who are most successful in teaching reading and communication skills to children from different cultural and linguistic groups. Characteristics include: sex, age, ability to speak language and/or dialects of students, familiarity with sociocultural systems of group or groups to which students belong, community in which reared, amount and type of training, attitudes toward cultural pluralism in education and cultural group membership. There is little data in this area related to teaching children from different cultural and linguistic groups. However, there is considerable literature on the characteristics teachers should have for effectively teaching mainstream American middle-class children. The methodology for this latter research is well developed.

APPROACH 9.3

LEARNING ENVIRONMENTS

Approach Statement

Determine which classroom arrangements, ethnic compositions of classrooms, and characteristics of school systems are more compatible with the incentive-motivational, human-relational, communication, and learning styles of children from different cultural and linguistic groups.

Problem Description

It seems probable that the organization of the learning environment will interact with the characteristics of children from different cultural and linguistic groups; it is important to discover what this interaction is.

Division of the Approach

The two projects under this approach will focus on the interaction of two kinds of variables. The first investigates the effects of matching classroom environment (e.g., open or structured or combination) with cognitive style. The second project will focus on effects of ethnic homogeneity and heterogeneity in the classroom. Communities in which members of different ethnic groups have a strong identification with the sociocultural premises of their groups and ethnically homogeneous and heterogeneous schools identified in each community, will be compared in light of the progress of their children in reading and communication skills.

APPROACH 9.4

THE ROLE OF THE COMMUNITY AND THE HOME

Approach Statement

Investigate the effects of community (parents, peers, siblings, and members at large) attitudes, beliefs, and involvement on the way children from different cultural and linguistic groups learn reading and communication skills.

Problem Description

Increasingly, theoreticians and practitioners have been accepting the idea that the discontinuity between informal and formal processes of learning reduces the effectiveness of the latter. Although the community, and specifically the home, has traditionally been identified as a socialization agent, and therefore participant in the teaching-learning process, the contribution made by each of the community's components to the acquisition of specific skills such as reading has not been well understood. This lack of knowledge becomes a crucial factor in efforts to educate groups of children from different cultural or linguistic backgrounds.

Division of the Approach

We divided the research within this approach into three major areas. The first deals with community attitudes and beliefs toward school, school achievement, and learning reading and communication skills. The other two programs are geared toward understanding parent involvement.

(1) The first program focuses on the community's perceptions of school, especially the activities related to the acquisition of reading. The goal is to study some of the basic elements upon which formal instruction in reading and communication skills may be built. Community attitudes are especially important in the following areas: (a) the attitudes and perceptions of a community toward learning English; (b) the attitudes of the culturally different groups toward their vernacular or group dialect; (c) the attitudes of parents toward the use of "nonstandard" or "nontraditional" methods and materials; and (d) the attitudes and beliefs of community members

toward school, school achievement, learning, and teachers. Clearly, each of the attitudes investigated can critically effect children's attitudes toward formal schooling and learning, and thereby effect their achievement.

(2) Parent involvement has mushroomed in the past decade, yet little is known about parents' perceptions of their involvement. Clearly, it is important to investigate the attitudes of parents with respect to their involvement in schools, particularly in the instruction of reading and communication skills.

"Involvement with schools," as the American educational establishment has traditionally defined is largely a cultural product. That is, it implies a tradition, a set of expectations, and very specific behaviors. Not all communities, much less all cultures, see and define their relationship to the social institution of schools in the same way. It is necessary, before further expansion of programs that encourage parents and community involvement in the schools, to obtain an adequate understanding of the attitudes of these groups toward involvement itself.

An illustration of the situation to be studied is the long history of failure with parent involvement within the Puerto Rican community in New York City. Superficial and culturally biased interpretations in the past have led educators to assume that parents lack interest in the school and its activities. Others have gone so far as to suggest lack of cohesiveness and group affiliations on the part of this population. It has not been until recently, with the advent of Puerto Rican researchers sensitive to cultural nuances, that more reasonable interpretation of the situation is emerging. The problem seems to have other explanations, such as the one that suggests that involvement may be understood in other forms. Research to substantiate this position is therefore necessary.

(3) During the past few years, persons other than teachers have been recruited--either as paid volunteers, paraprofessionals, or simply volunteers to help in various facets of teaching communication skills. Evidence in the form of program evaluation has been accumulated, the general tone of which has been positive. Nonetheless, not all culturally or linguistically different groups have participated in this type of experience. We therefore suggest an inventory of such programs with evaluations as to their effectiveness in facilitating the learning process, particularly of reading skills.

APPROACH 9.5

INSTRUCTIONAL MATERIALS

Approach Statement

Identify characteristics of instructional materials consonant with the learning, incentive-motivational, human-relational, and communication styles of children from different cultural and linguistic groups.

Problem Description

Research suggests that the historical and cultural content of material may influence students' motivation to read, especially if the material is relevant to their culture. Materials also affect the students' self-concepts as well as their concepts of their cultural group, particularly if the students' culture is excluded from the material, or portrayed negatively, or if the culturally relevant materials are of poor technical, artistic, or literary quality. Research also suggests that materials congruent with the values of the culture (e.g., preferred learning styles, emphasis on cooperation or competition) are more effective vehicles of instruction than those alien to the values of the culture.

Division of the Approach

Instructional materials, therefore, represent an important area for research. The panel divided the investigation into three areas:

(1) It is usually assumed that materials and approaches effective for children of the dominant culture are also effective for all other children. This assumption has been seriously questioned. This program will encourage examination of existing materials and approaches for each linguistic and cultural group. This step is a necessary preliminary to developing new instructional materials.

(2) It is important, as well, to investigate the effects of instructional materials with obvious cultural content on the way students from different cultural and linguistic groups learn

reading and communication skills. This program is extremely important because there is research that suggests that material with cultural content is a more effective instructional vehicle than traditional materials.

Research efforts in this area present few difficulties and potentially great rewards in terms of students' motivation, self-concept, concept of their cultural group, and reading ability. This research could also be an aid to increasing the use of such materials in schools and educational programs.

(3) It is important to investigate the effects of instructional materials used in the home. This investigation should include within its scope materials used in both formal and informal situations.

Home instructional projects have usually been examined with respect to the procedures used, but not the materials. The need to fill this gap is great, and the value of this project is significant. Because parents are concerned about the effects of reading materials in the home, an examination of the informal use of materials can be equally important, especially if the results can be disseminated to parents and the public.

APPROACH 9.6

ASSESSMENT

Approach Statement

Identify characteristics of assessment instruments, techniques, and materials necessary for effective assessment of reading and communication skills of children from different cultural and linguistic groups and for assessing teaching strategies, learning environments, instructional materials, and communication skills for culturally and linguistically different children.

Problem Description

Research has shown that traditional forms of testing and assessment (i.e., achievement, I.Q., and reading tests) have been detrimental to children from different cultural and linguistic groups. Most standard tests and other forms of assessment presently in use in the schools are inappropriate for children who do not belong to the American mainstream middle-class. Although the use of assessment instruments has become institutionalized in this country, a critical appraisal of most assessment instruments would reveal that they are inappropriate for culturally and linguistically different children for the following reasons:

(1) Most assessment instruments have not been standardized (normed), validated, or designed for children from cultural and linguistic groups other than the American mainstream.

(2) Traditional tests and materials employ inappropriate language. Frequently, the language is a type of English unfamiliar to children from different cultural and linguistic groups.

(3) The content of such materials is usually ethnocentric and culture-bound to the group for which it was developed; in this case, the American middle-class child of the last few decades. Material often has no relevance socially, culturally, or psychologically for children of different cultural and linguistic backgrounds. Foreign language translations of American tests are also inappropriate

because the content is still culture-bound, even though presented in a language comprehensible to the child.

(4) Last, and perhaps most important, is the testing situation itself. For children of different cultural and linguistic backgrounds, the idea of testing is often both physically and psychologically frightening. Children from these groups are very often not prepared (because of differences in culture and value systems) to be able to perform, and in some instances even to cope with the traditional testing situation. For example, to perform on a test of achievement in front of an examiner from a different background and primary language can be extremely detrimental to a culturally or linguistically different child.

Given that the use and misuse of assessment instruments has been and continues to be detrimental and of little real value for the assessment of children from different cultural and linguistic backgrounds, the panel suggests that an alternative is to identify those culturally and linguistically appropriate assessment instruments that exist and/or develop new and appropriately designed instruments in the areas where they are necessary.

In this panel's view, the central issue is whether we should use assessment to categorize deficiencies, failures, and faults, or whether assessment should emphasize the gathering of data and knowledge about groups, individuals, and behavior we can use for descriptive and prescriptive purposes. The panel believes that the latter should be the role of assessment as it relates to children from different cultural and linguistic backgrounds. Moreover, assessment is to be used to comprehend and gain knowledge about areas not usually subsumed under the heading of assessment. For example, assessment of teaching methods could be employed to devise more effective methods of teaching children.

Division of the Approach

Consonant with the above discussion, the research programs suggested have been designed to (a) incorporate existing knowledge and data concerning assessment, and (b) devise new and better assessment methods and materials.

(1) The investigations proposed in this area would entail the indepth review of all major assessment instruments and techniques now popular which have an effect on the learning process as it relates to reading for children from different cultural and linguistic groups.

Undertaking research of this type offers many advantages. First, there is a wealth of information already available. Second, the costs

would not be as great as other research projects since it is a review investigation. Third, it would form the basis for the following program within this approach. It is also crucial to the success of the other approaches of this panel.

(2) Research under this program would entail the search, examination, and development of assessment instruments and techniques which could be used for assessing learning styles, teaching styles, learning environments, instructional materials, and community participation.

This program offers the foundation for developing assessment instruments and strategies for teaching reading and communication skills to children from different cultural and linguistic backgrounds. The importance of this area cannot be overstated. With the ability to assess learning and teaching styles, for example, students can be matched with teachers and vice versa.

(3) Investigations have revealed that test and assessment instruments and techniques are affected either positively or negatively by such variables as examiner bias, language bias (or differences in interpretation), test atmosphere, and attitudes of both the person being tested and the examiner. Research in this area will focus on isolating those variables which affect testing and test results, the culturally and linguistically different child, and the process of learning to read and communicate.

If assessment of children is to continue in the schools even with new and better instruments, the dynamics of those being tested and those administering tests must be understood. The implications are clear for effective assessment programs.

PANEL 10

ESSENTIAL SKILLS AND SKILL HIERARCHIES IN READING INSTRUCTION

APPROACH 10.1: IDENTIFICATION AND VALIDATION OF BEHAVIORS ESSENTIAL OR SUPPORTIVE TO THE ACQUISITION OF COMPETENT READING BEHAVIOR

- Program 10.1.1: Compilation of Skills in Assorted Instructional Programs or Systems
- Program 10.1.2: Identification of Potential Supportive and Essential Skills Not Specified by Existing Curricular Programs
- Program 10.1.3: Validation of the Relationship Between Specific Skills and the Acquisition of Reading Competence

APPROACH 10.2: IDENTIFICATION OF THE FACTORS WHICH INFLUENCE THE LEARNING AND DEVELOPMENT OF ESSENTIAL AND SUPPORTIVE SKILLS

- Program 10.2.1: Studies in Perceptual Learning and Development
- Program 10.2.2: Studies in the Acquisition of Intermediate Decoding Skills
- Program 10.2.3: Meaning and Comprehension

APPROACH 10.3: EMPIRICAL DETERMINATION OF THE OPTIMAL HIERARCHICAL ARRANGEMENT OF THE SKILLS ESSENTIAL TO SUCCESS IN READING (OR IN THE DOMAIN SUBSUMED BY THE LABEL "READING")

- Program 10.3.1: Selection of Research Methods
- Program 10.3.2: Validation of Instructional Hierarchies in Reading
- Program 10.3.3: Validation of Hierarchies on Different Populations

PANEL 10

ESSENTIAL SKILLS AND SKILL HIERARCHIES IN READING INSTRUCTION

Problem Area Statement

This panel focused on issues central to identifying essential reading skills and to organizing these skills into instructional hierarchies. We made some attempt to place these issues into a broader focus: the assumptions implicit in the selection and sequencing of reading skills were themselves brought into the open and questioned.

The implications for practice, for issues both relevant and important to concerns of educators today, are extensive. Both educational policy and instructional decisionmaking require information about skill hierarchies to deal with some of today's most pressing issues: curriculum development; individualized instruction; diagnostic and prescriptive teaching; and teacher-school accountability.

Consider for a moment the importance of skill hierarchies to the development of individualized instruction. Growing dissatisfaction with the lock-step of graded instruction, with its failure to resolve the problem of illiteracy for large segments of the population, has led to an increasing emphasis on the individualization of instructional practice. Such individualization has taken several forms. Objective-based systems are one relatively new technique for facilitating individualized instruction. These systems depend on the validity of the hierarchies which underlie them. Yet evidence about the effectiveness of the systems and hierarchies is wanting.

Consider too the importance of skill hierarchies to the recent trend toward teacher-school accountability. While we can use norm-referenced measures to demonstrate general growth in reading performance with respect to the general population, traditional norm-referenced tests do not provide the information necessary for accountability-related assessments. Information about the growth of reading performance with respect to a body of well-defined skills is essential. The establishment of skills-based systems and the attendant criterion-referenced measures could lead to a more equitable and relevant method of assessment for both teacher and student.

Relevant Research

In short, the concept of essential skills and skill hierarchies permeates current education practice. The idea as yet does not enjoy the benefit which more precise documentation might confer upon it. In fact, the idea is based on three assumptions which, for the most part, are neither stated nor tested: (1) essential skills do exist, and these skills can be taught; (2) instructional hierarchies also exist, that is, sequences of learning activities systematically building upon each other, eventually culminating in reading competence; (3) a skill-oriented instructional program is pedagogically efficient and effective. The testing of this third assumption, while critical to the construction of optimal methods of reading instruction, depends upon results from investigation of the first two. The panel therefore focused on confronting the issues raised by the first two assumptions. It noted, however, that validating lists of essential skills and skills hierarchies should not be considered a validation of any specific instructional methods, especially one in which skills are taught in isolation from other skills.

Division of the Research

Approaches to the problem at hand reflect the two major tasks of this panel: constructing a research agenda leading to the description of both essential skills in reading and optimal organization of these selected reading skills. The first task was divided between two approaches: identification of essential skills as reflected in current curriculum materials, and the identification (and classification) of the psychological processes underlying essential skills. The second task served as a single approach, i.e., the validation of hierarchical relationships among essential and supportive skills.

APPROACH 10.1

IDENTIFICATION AND VALIDATION OF BEHAVIORS ESSENTIAL OR SUPPORTIVE TO THE ACQUISITION OF COMPETENT READING BEHAVIOR

Approach Statement

Identify and validate perceptual, conceptual, and linguistic behaviors essential to reading.

Problem Description

Published lists of reading skills reflect the thinking and experience of many educators and researchers. Moreover, recent research has suggested performance behaviors not included in existing lists that may qualify as essential or supportive skills. Such information should be incorporated in future efforts. The goal of this approach is to determine whether skills identified either from existing lists or from research findings represent behaviors unnecessary, supportive, or essential to the performance of a terminal reading objective.

Relevant Research

Insofar as we do not have a fully specified model of reading acquisition, we cannot actually validate a particular skill. Moreover, we will have to wait upon such a model to assure us that we have actually identified all of the appropriate skills. Nonetheless, we believe that the body of available knowledge supports, indeed demands, focused inquiry of the sort we propose.

Division of the Approach

The task has been divided into three programs. The first calls for a compilation of skills from existing lists, the second calls for identification of potential skills from recent research. The third program is directed at validating the candidate skills.

(1) The lists now in use contain a wealth of information well worth tapping. This program is directed toward providing an exhaustive compendium of skills included as essential or supportive in any

instructional program. This program will provide candidate behaviors for validation by the third program discussed below. In addition, it will have an immediate practical use. The data collected will provide a source of information about which instructional programs include any given skill. The dissemination of the results of this program will be a considerable aid to reading teachers who are concerned about including instruction in certain skills in their curriculums.

(2) We cannot assume that current curricular programs have identified the complete set of essential skills for reading, especially in the area of reading comprehension. Basic research in both learning to read and reading comprehension has suggested "new" skills, i.e., behaviors as yet unidentified in current curricular programs, or standards of behavior which go beyond accuracy of performance. For example, a recent study has shown that mastery of a skill may involve more than correct performance; it may involve facility of processing, or automaticity. This program will help to provide a complete list of those reading skills which have only recently been suggested by basic research.

(3) The basic question which remains unanswered by the first two programs, is of course the question of which skills are in fact "essential" to reading. This program will focus on answering this question empirically by establishing a relationship between a specific skill and the terminal objective of reading or between the skill and some other skill already identified as essential to reading.

APPROACH 10.2

IDENTIFICATION OF FACTORS WHICH INFLUENCE THE LEARNING AND DEVELOPMENT OF ESSENTIAL AND SUPPORTIVE SKILLS

Approach Statement

Identify factors which influence the learning and development of essential skills and the nature of this influence.

Problem Description

It is not enough to have identified essential and supportive skills. In order to continue building the body of information needed to construct efficient and effective instructional programs, we need to understand the perceptual, linguistic, and cognitive processes which aid or hinder the acquisition of the skills.

Division of the Approach

The three programs in this approach focus on attaining a better understanding of (a) visual and auditory perceptual skills and their relationships to the development of reading competence, (b) the effect of nonlinguistic information, syntactic and semantic contextual constraints, and readers' informational backgrounds on reading, and (c) cognitive processes and competencies critical to the derivation of meaning.

(1) During the past few years, researchers have devoted considerable effort to investigating aspects of visual perceptual skills and their development. They have collected much correlational evidence concerning the relationship between these skills and performance in reading. Similarly, in the area of auditory skill development, it has been demonstrated that children who are having difficulty in beginning reading instruction very often are unable to perform well on auditory tasks such as analyzing parts of words or blending phonemes. Preliminary work suggests that instruction in fundamental auditory skills may transfer to the acquisition of early reading skills. This program will explore the relationships among auditory skill development, visual skill development, and reading.

(2) It is quite clear that fluent readers use a number of sources of information in the process of reading. Graphic information is but one source used in the word identification process. Orthographic information, lexical information, semantic and syntactic information, and nonlinguistic cues may all aid the process of reading. Techniques for teaching children to integrate these sources of information with word recognition strategies in order to speed the recognition process and make it more automatic are being devised. This program will attempt to determine those factors which influence the use of these various sources of information in reading.

(3) A major objective in essential skills instruction is the development of reading comprehension abilities that will enable the child effectively to derive, interpret, evaluate, and apply meaning. The nature of the cognitive processes underlying skill competencies that lead to comprehension, however, is little understood. Underlying competencies suggested by recent studies include knowledge of word meaning, ability to draw inferences, ability to recognize the writer's purpose, attitude, tone, and mood. This program will attempt to identify those processes and competencies necessary to comprehension and to relate their development to the overall development of logical thinking in the child and to the child's experiential background.

APPROACH 10.3

EMPIRICAL DETERMINATION OF THE OPTIMAL HIERARCHICAL ARRANGEMENT OF THE SKILLS ESSENTIAL TO SUCCESS IN READING (OR IN THE DOMAIN SUBSUMED BY THE LABEL "READING")

Approach Statement

Empirically determine the optimal hierarchical arrangement of the skills essential to success in reading.

Problem Description

At the present time there is no dearth of lists of essential reading skills. Such lists are given in curriculum guides, in manuals of instructional programs, and, most explicitly, as the bases for skill-centered, objective-based approaches to teaching reading. As lists, they tend to share reasonable face validity and the support of one or another educator or appropriate authority.

However, the hierarchical arrangements of these skills, where they are so arranged, have not been empirically derived or validated. In some cases, present knowledge does not permit the fine breakdown of skills subsumed by a terminal objective such as "comprehension of text." The validation of a hierarchy for any domain cannot reasonably proceed until the specific skills for that domain have been identified, critically analyzed, and empirically validated. In other cases, the validation efforts have been beset by methodological problems.

An interesting result may attend future research efforts to identify and validate hierarchies. It is possible that the attempt to create valid hierarchies may only serve to demonstrate the nonexistence or the relative unimportance of hierarchical relationships among skills in the various domains. This discovery in itself would be useful. While the salutary effect on instruction of proper hierarchical arrangements of skills seems obvious, there would also be value in knowing if and where such arrangements are not important.

Division of the Approach

The approach was divided into three programs; the successful completion of the first is a prerequisite for most projects under the remaining two.

(1) Currently, hierarchies are most often "best guesses" generated by a task analysis or by some other logical (nonempirical) analysis of reading. The hierarchies are only infrequently based on hypotheses derived from comprehensive models of reading behavior. Because the basic methodological issues involved in generating and validating hierarchies have not yet been settled, the first program in this approach focuses on the research methodology itself.

(2) We will use the research designs selected under the previous approach to examine the relationships among elements of hierarchies explicitly or implicitly contained in published reading programs, management systems, and teachers' own instructional schemes. The panel recommends that consideration be given to projects to investigate hierarchies representing different levels of skills specificity or units of behavior. The research programs should include the validation of hierarchies relating to relatively large units of analysis as well as those relating to much more finely scaled units of behavior. This tack seems preferable to an attempt to exhaust the possible hierarchies at any one level of specificity.

(3) Finally, it may be possible to tailor hierarchies for specific subpopulations. The last program would focus on this tailoring. Though there have been numerous studies attempting to validate different instruction methods for subpopulations ranging from certain cultural groups to populations designated as having auditory, visual, or kinesthetic preference for learning, these studies have not for the most part been successful. Any proposal for research under this program should explain this lack of success, and should give evidence for promising directions.